Welding Engineer

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APRIL, 1958

Welding Show Issue

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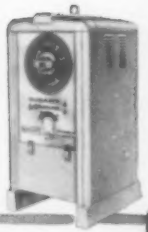
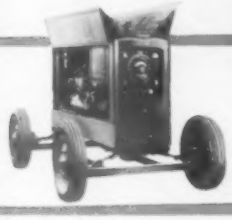


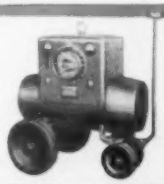
DC Rectifier Sizes 300-400 ampere

AC/DC Welder 200 ampere combination

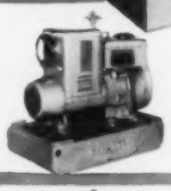


Gas Drive Size 300-400 & 600 ampere

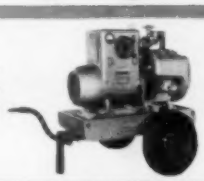
Get the arc welder that's RIGHT for you— ...get a HOBART!



Electric Drive Sizes 200-300 400-600 ampere



"Husky Boy" Air-cooled 200 amp.

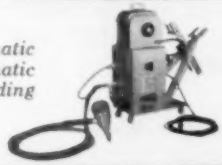


AC/AC Welder for AC power or AC welding

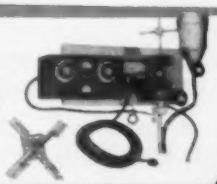
"Contractor's Special" Water-Cooled 250 amp. size

Weldmobile Sizes 400-600 ampere

"Powromatic" for automatic arc welding



Handomatic Semi-Automatic arc welding



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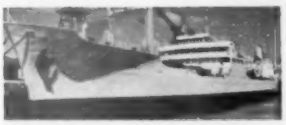
Vol. 43 — No. 4

Welding Engineer

The magazine of joining and severing materials

This is welding: April, 1958



A wine tanker with a "stainless" reputation for quality 38

▶▶▶▶▶▶ **Philip Ferry** describes steps taken in welding the world's first tanker designed principally for wine transportation.

Welded yawl cops cups 42

What's new on the high seas? **F. W. Foerste** says it's all-welded aluminum yawls. Full welding details and ship facts highlight this article.

Solution to A. O. Smith's problem is a welding school 45

How to get best welding performance in a large corporation—a not-uncommon problem. Here's why this firm backs its welding school approach.

Whys and hows of stress relieving 47

Gerald Scott of Hobart Bros. Co. defines his terms, then presents one of the fullest descriptions of stress relief principles ever published by WE.

A "common" job cost this firm too many $ $ $ 52

R. H. Hoefler recounts costly steps which had to be taken when Kaighin & Hughes, Inc., agreed to weld reactor vessels and heat exchangers.

Self-imposed welding standards 54

Rules and regulations for better welding which American Machine & Foundry Co. set for itself are cited as good examples of what other firms might do.

Super shovel hefts tons of earth in a quest for coal 116

▶▶▶▶▶▶ **Tom Learmont** of Bucyrus-Erie tells again the story that won him $5,000 in the Lincoln Arc Welding Foundation machine design competition—that of the 2,400-ton River Queen coal shovel.

Plus—preview coverage of important new products to be displayed at the AWS Welding Show, beginning on page 98

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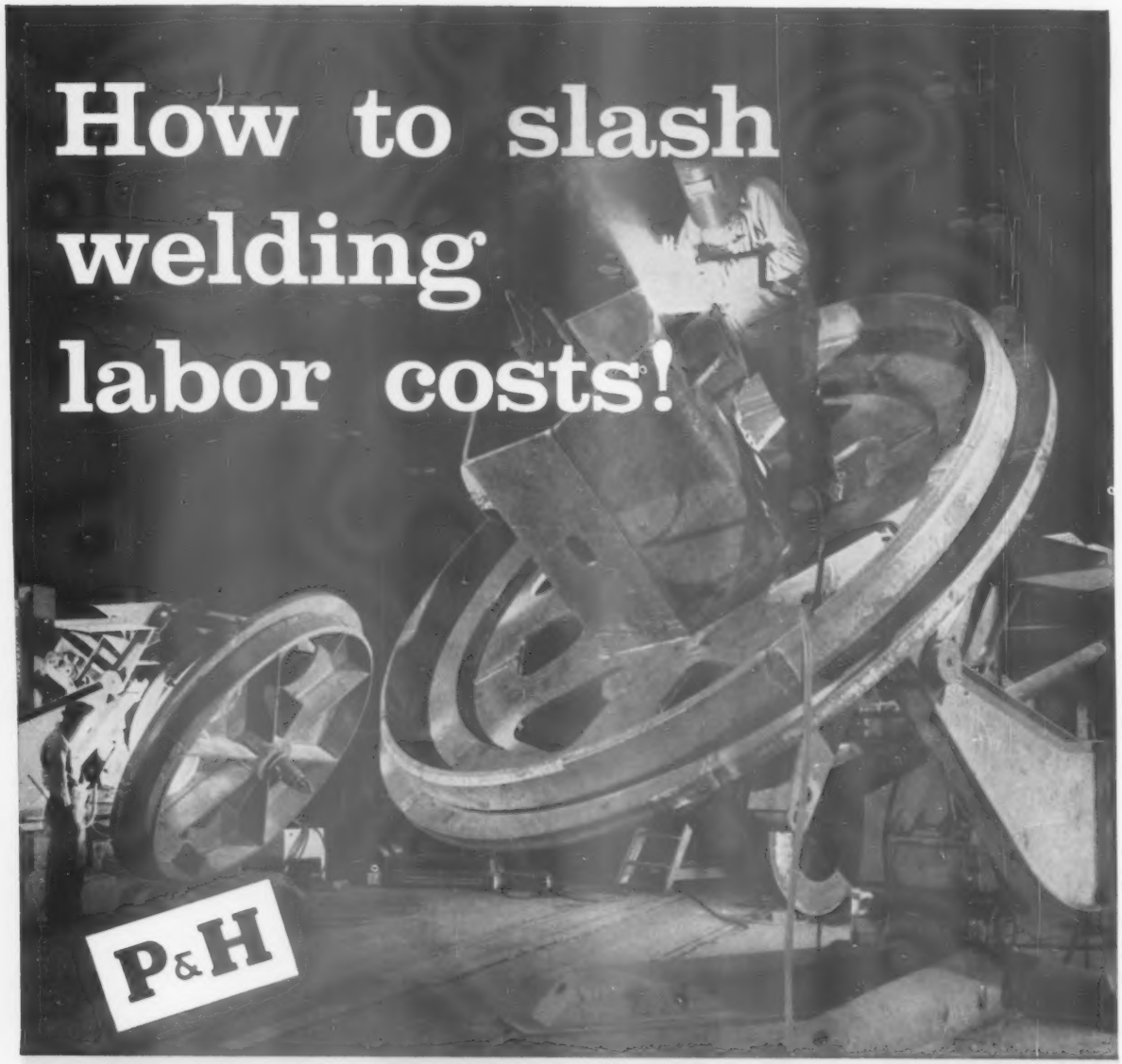

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P&H Welding Positioners can often cut labor costs in half by providing faster, safer, *mechanized* weldment handling. With these modern machines, operators merely press a button to quickly spot the work so that all welds are made downhand — in the natural position.

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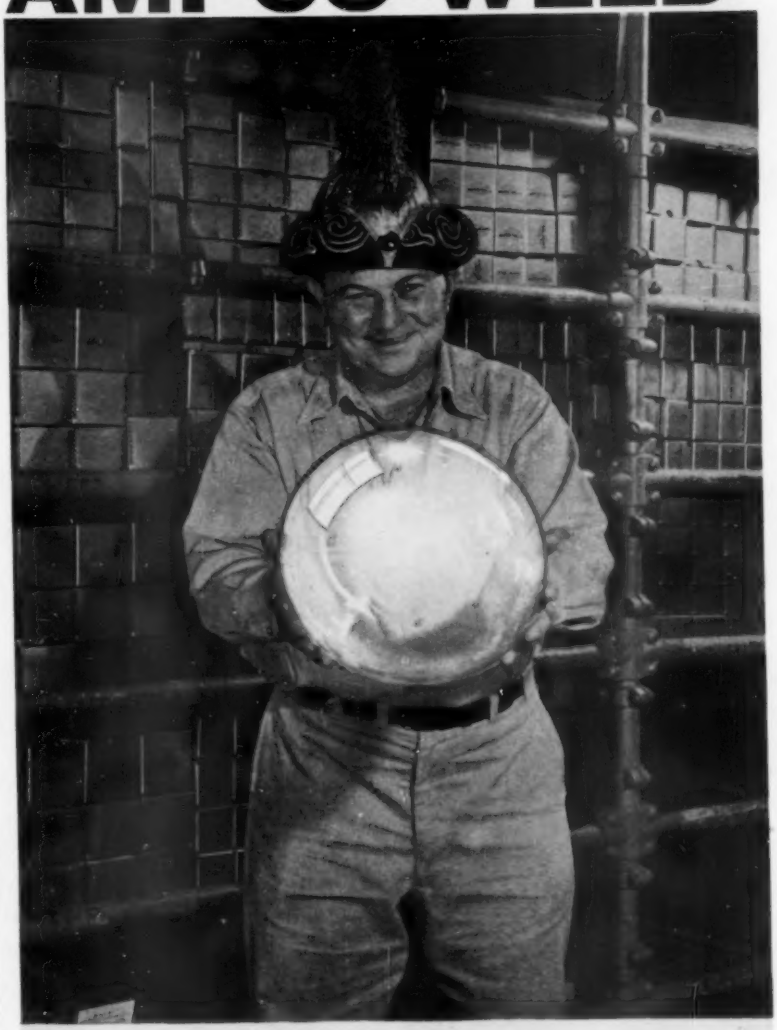

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Monthly inventory list tells which shapes and sizes of Ampcoloy 99-97-95 bars and rods for resistance welding and high-conductivity use you can get *off the shelf* through your Ampco-Weld distributor. Often makes it unnecessary to incur the extra expense and delay of special orders or machining.

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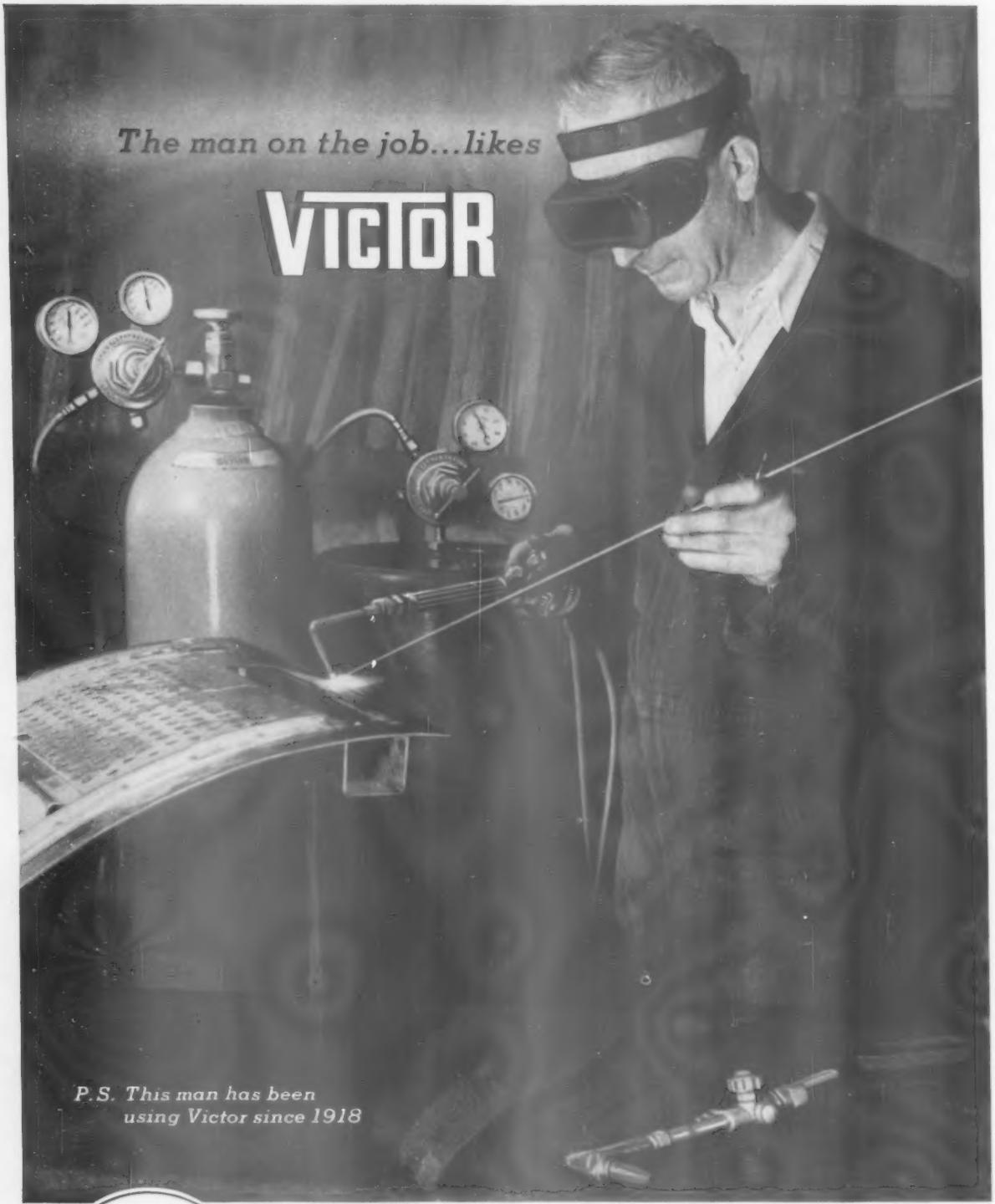

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VICTOR for welding

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ABOVE: This 16½-ft diameter boiler head is being welded at the plant of Phoenix-Rheinrohr A.G., in Duesseldorf, West Germany. RIGHT: Powerful circle of floodlights provides light for Chicago Bridge & Iron Co.'s night shift, working to erect a 190-ft diameter Hortonsphere near Chicago. (See story below.)

News

1st Canadian seminar in structural steel welding

The War Amputations Auditorium, Toronto, will be the scene of the Canadian structural steel industry's first welding seminar April 8 and 9. It is sponsored by Air Reduction Canada, Ltd. Participants include: L. J. Taylor, vice president of Air Reduction Canada; D. C. Beam, general manager, Canadian Institute of Steel Construction; R. M. Gooderham, general manager, Canadian Welding Bureau; W. R. Stickney, Canadian Welding Bureau; LaMotte Grover, welding engineer, Air Reduction Sales Co.; Prof. D. T. Wright, civil engineering department, Queens University; A. Phillips, vice president, Sparling Tank & Mfg. Co.

Plans for the meeting include lectures and a panel of experts. Grover will deliver four talks during the two-day session.

Nixon speaks at AtomFair

Vice President Richard M. Nixon recently addressed the All-Congress banquet, part of the Chicago AtomFair sponsored by the Atomic Industrial Forum, Inc., March 17 through 21. The banquet was held at the Palmer House. Atomic Energy Commission Chairman Lewis L. Strauss introduced the vice president. Purpose of the meeting was to display a cross-section of the products and services available for putting the atom to work for peaceful purposes.

Hobart North buys Gasflux Supply

Hobart North Welding Supply Co., Chicago, is taking over assets of Gasflux Supply Co., also of Chicago. Hobart North is exclusive distributor for Vap-R-Flux, product of newly-formed Vap-R-Flux Corp., Mansfield, Ohio. Charles P. Feebusch, owner of Gasflux Supply, is retiring. He is a consultant to the Vap-R-Flux firm.

Ornamental iron men organize

At its recent convention in Memphis, Tenn., the Ornamental Iron Manufacturers Association was founded. Officers for this year are: Frank Kozik, Scranton, Pa., president; Charles Morris, Sheffield, Ala., vice president; Charles Graham, Atlanta, secretary; R. W. Colver, Danville, Ill., sergeant-at-arms.

Night becomes day on welding job

Darkness can't stop work on a 190-ft diameter "Hortonsphere" being built to house the Dresden Nuclear Power Station's atomic reactor. A powerful circle of floodlights illuminates the area, near Chicago, for the night shift. Exterior lights plus a number mounted midway and at the top of a 210-ft tower in the tank allow all phases of construction to continue into the night. The tank is scheduled for completion this month. *(See March* WELDING ENGINEER, *p. 35.)*

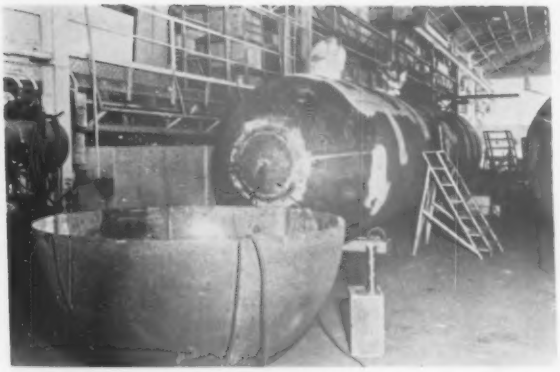
Airline Welding in new quarters

"A far cry" from its old quarters is the new building Airline Welding and Engineering Co. recently moved into, reports President B. R. Russell. The 3,000 sq ft building in Hawthorne, Calif., houses general and sales offices.

Announce plans for Gregory award

A five-man jury headed by Dr. Clarence H. Lorig, vice president of the American Society for Metals, and assistant director of Battelle Memorial Institute, will select the winner of the $1,500 cash award. It is given for the year's outstanding contribution to the advancement of electric arc stud welding.

Three Paris subway engineers won the first Gregory competition last year for their use of stud welding to convert subway track for the operation of noiseless rubber-tired trains. *(See December's* WELDING ENGINEER, *p. 38.)*



ALL-welded, frameless construction of these steel tank trucks reduced operating and maintenance costs. LPG tanks of T-1 steel were completely hand-welded to X-ray quality, Arcos Corp. reports. (See story below.)

REMODELED store of Acetylene Welding Supply Co., San Antonio, has doubled showroom and service facilities. Owner Fred W. Smith, Jr. (left) and son David, partner and sales manager, in front of their store.

Produces all-welded, frameless tank truck

Frames were a major source of maintenance trouble in tank trucks, so Superior Tank and Construction Co., Los Angeles, did away with the frames. The new, all-welded construction improves payload and eliminates about 1,000 lb of dead weight, the firm reports. The axle, wheel and spring assembly are attached to the tank body which is made of T-1 steel. For welding the tank and the wheel assembly to the tank, "Ductilend 110," a new low alloy high tensile strength electrode, was used.

LeTourneau wins "Beaver" award

Close to 1,000 leaders in the heavy construction industry saw Robert G. LeTourneau receive a "Beaver" award at the Beaver's annual awards dinner in Los Angeles recently. Le Tourneau, longtime advocate of welding, has designed and developed equipment for the construction industry for more than 30 years.

Build reactor vessel for first atomic ship

The reactor vessel for the prototype nuclear propulsion plant of the nation's first atomic-powered surface ship program was recently delivered. The 100-ton pressure vessel has a flange 18-in. thick with an outside diameter of 137 in. It was machined from a 70-ton forging. Vessel shell is formed from 7-in. thick alloy steel plate and is 105 in. in diameter. Measuring over 19 ft long, the reactor vessel body is made of manganese-molybdenum alloy steel. It is the 2nd largest pressurized water reactor type built to date, firm reports.

The vessel was welded at Foster Wheeler Corp. by submerged arc welding, and all pressure welds were examined by X-ray. Stainless steel cladding on the vessel flange was deposited by a special automatic weld cladding process.

Linde supplies oxygen for Detroit steel plant

An automatically-operated oxygen plant is being built by Linde Co. at the site of Detroit Steel Co.'s operations at Portsmouth, Ohio. The plant will produce 20,000,000 cu ft of high-purity gaseous oxygen a month for use in furnace operations, welding, cutting and maintenance.

The unit is designed for automatic, unattended operation. An electronic monitoring system reports continuously to a central office. The new plant will go on-stream in 1958, Linde reports.

Earlbeck & Landrum get new building

Leaving Baltimore, the firm of Earlbeck & Landrum, Inc., is moving into a new building at 8041 Pulaski Highway in Baltimore county. The new building and land cost about $75,000 and includes a 7,000 sq ft, one story, all-welded steel and concrete building, and over 35,000 sq ft of storage space for rental welders and parking.

A. C. Earlbeck and W. C. Landrum joined C. H. Basel to form BEL Welding Supply Co., Inc., recently. The new firm is located at 1921 47th Ave., N.E., Washington, D.C. Landrum serves as president, Earlbeck as vice president and C. H. Basel as secretary-treasurer.

Lincoln Electric honors chairman

James F. Lincoln received his 50-year service pin at a recent employees' banquet in Cleveland. In 1907 Lincoln joined the firm as the only salesman. He became general manager in 1914, president in 1928 and chairman in 1954.

Also honored at the banquet were 208 firm employees with the firm for 10 years or more. Mike Pavelik, machinist and tool maker, has been with Lincoln for 40 years.

"Space cabin" all-welded

The space cabin which, with Airman Donald Farrell inside, recently made a simulated "trip to the moon," is all-welded. Newspapers across the country carried the story of the experimental trip to outer space which was conducted at Randolph Air Force Base in San Antonio, Texas.

Manufactured by American-Marietta's Guardite Div., Wheeling, Ill., the test chamber affords the wide

(Continued on page 139)

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- how do gases mix in a torch
- what are the more important flame temperatures
- which is hotter — the oxydizing or carbonizing flame
- why do some flames heat rapidly and others slowly
- can you guess the speed of a gas molecule

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30 YEARS AGO

(Taken from *The Welding Engineer* of April, 1928)

An editorial asks, "Is it beneath the dignity of an engineer to know how to handle the torch or the arc?" While an engineer cannot be expected to practice enough to be perfect, he profits by being able to weld better than the average operator, the article concludes.

—30 YEARS AGO—

The annual meeting of the American Welding Society was held in New York City April 25, 26 and 27.

—30 YEARS AGO—

Spot and flash welding make an entirely new kind of Ford automobile, a major article, "Resistance welding aids redesign," points out. Mr. Ford, with characteristic keenness, was ahead of his time in recognizing that welding was the keystone process upon which depended the further development of the best of manufacturing processes.

—30 YEARS AGO—

A 45-mile, high pressure pipe line from Lamkin, La., to Hodge, La., has been fabricated entirely by arc welding. The line was welded by the Big Three Welding and Equipment Co., Houston.

—30 YEARS AGO—

Jacob Savela has been appointed welding service manager of Lincoln Electric Co.'s Detroit district. He will be under the direction of J. M. Robinson, district sales manager.

—30 YEARS AGO—

What's in a name? New chairman of the Chicago section of the American Welding Society is Robert G. Longweld, Link-Belt Co., Chicago.

—30 YEARS AGO—

Sell welding on quality, advises an editorial. Pipe welding can be sold either as a cheaper process or a better process. Stress the fact that it is superior.

—30 YEARS AGO—

Cheaper and more dependable welding has been adapted by the U. S. Navy for welding aerial practice bombs.

—30 YEARS AGO—

Magnolia Gas Products Co. is at work erecting a new oxygen plant in San Antonio, Texas.

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by AUTOMATIC arc control.

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H&M TM REG

PIPE BEVELING MACHINE COMPANY
311 E. Third St. Diamond 3-0241
TULSA, OKLAHOMA

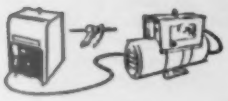
APRIL
1958

Your

Weld World

at press time

Last minute news of interest to those engaged in joining and severing materials.



. . Printed circuits have been adopted by the welding industry. Portion of control mechanism for Airco's new "push-pull" guns has such a circuit. For other details, see page 106 of this issue.

. . Good news for those of us who have expense accounts. Treasury Department has reversed its earlier ruling on reporting such funds as added income, then making detailed deductions. Now, if your employer requires detailed accounting, you need not report this money to tax collector. But if amounts are large, and your boss does not make you account for any of it, you'll have to fill out line 6(a) when filing 1958 income-tax forms next year.

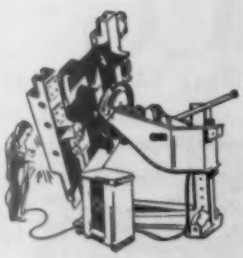
. . Metal & Thermit reports its 1957 sales held at near-record levels, established in 1956. Last year's net sales were $42,200,580, compared with record $42,222,677 of year before. Gross profits stayed at same levels, except in welding division, where they dropped because of cost-price squeeze.

. . Steel mills are inching upward in output because steel users are rapidly depleting inventories, which have been large. Production should hit peak by mid-summer.

. . Demand for aluminum, too, may be on way up. Kaiser reports increase in call for mill-fabricated aluminum products in first two months of this year.

. . Glove Division of Riegel Textile Corp. lowered its prices for this year, expressing regret that such action was necessary, but felt it must recognize ". . . under-the-list selling that has been taking place in the market."

. . Study of ultrasonic welding is being conducted for Air Force by Battelle Memorial Institute. Research is to determine value of ultrasonics in spot and seam welding high-temperature alloys used in modern aircraft. Also, scientists will seek better understanding of how ultrasonic or vibratory energy causes metals to join.

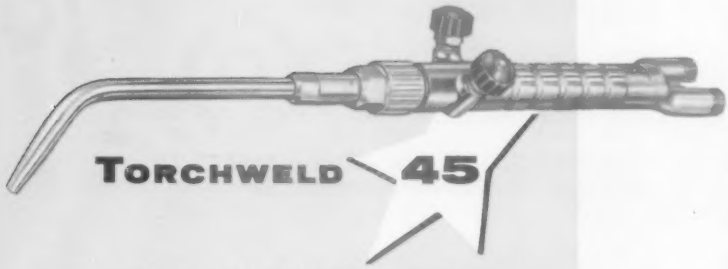


. . Two fully automated lines of resistance welders and allied equipment will be furnished Westinghouse Electric Corp. by Federal Machine and Welder Co., Warren, Ohio. Lines are designed for high-speed fabrication of automatic washer tubs.

THE WIDE-RANGE, ALL-PURPOSE WELDING TORCH

This is the torch *par excellence* for all types of work, from 28 gauge sheets to 1" slabs or more. Has easy-adjustment non-seizing valve mechanism for precise control of gas pressure and flow. Mixer blends gas perfectly, delivers to tip without restriction. Both swaged and drilled tips are available to provide required flame characteristics.

Rugged, tough stainless steel tubes . . . silver-brazed at head and base. Lightweight, strong brass handle, grooved to give sure grip and control. Mixer has buna seating rings for leakproof hand-tightening. No metal-to-metal contacts. No scratching or scoring. No costly reseating of torchhead.



THE LIGHT AND MEDIUM DUTY WELDING TORCH

For automotive welding, pipe welding, sheet metal fabrication, steam-fitting, etc. Aluminum handle, lightweight but rugged. Valve wheels placed conveniently at front end, under the thumb. Mixer delivers perfectly mixed gases. Mixer has buna seating rings for leakproof hand-tightening.

FAMOUS BANTAM® WELDING TORCH

Ideal for welding aluminum, alloys, aircraft tubing, steel from 28 gauge to ⅜" thick. Lightweight, easy to handle, compact for use in tight quarters.

Valve wheels placed conveniently at front end, under operator's thumb. Special nickel alloy tubes, silver-brazed at head and body. Non-seizing, non-scoring stainless steel valve stems. Mixer designed for perfect gas mixing.

TORCHWELD®

The All-Star Line of Welding and Cutting Equipment

In this outstanding line of regulators, torches, tips and accessories you will find features galore. Operating features that boost production, handling features your operators go for: cost-cutting features, durability and dependability. All backed by a great manufacturing and engineering organization and a nation-wide network of dealers offering prompt service in every respect. Ask your nearest authorized NCG dealer or NCG office for a demonstration. Or write for a complete catalog.

NCG®

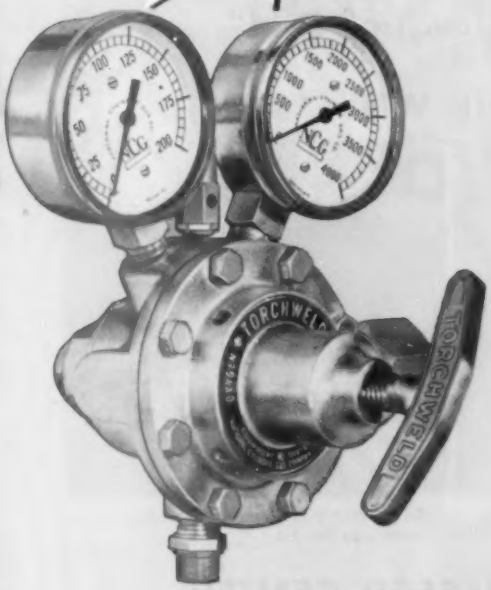
NATIONAL CYLINDER GAS COMPANY

840 NORTH MICHIGAN AVENUE, CHICAGO 11, ILLINOIS

Branches and dealers from coast to coast

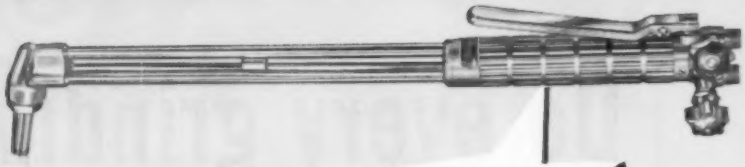
See us at the

TORCHWELD 6500 Regulators



TWO STAGE PERFORMANCE AT SINGLE STAGE COST

The best features of both types of regulators—the *dis*advantages of neither . . . that's what you get in the 6500 Series Regulators. That's because of the patented pressure compensating chamber. It maintains desired set pressure *throughout the usable cylinder range!* Yes, here's simple construction, low initial cost, and the precise control of pressures and volumes found elsewhere only in the more expensive two stage regulators.



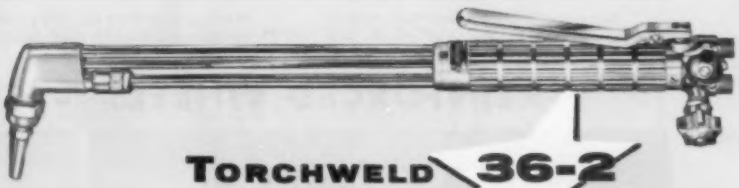
TORCHWELD 75-1

THE OUTSTANDING CUTTING TORCH

This is the ideal performer for operations of any size or any kind, from small shop to huge mill. Cuts sections up to 16 inches thick.

Pressure-forged, rugged brass valve body; non-seizing stainless steel needle valve stems. Non-warping forged bronze or abuse-resistant nickel alloy heads. Nickel-alloy tubes, set in self-reinforcing triangular formation. Silver-brazed into handle and head. Precision-swaged tip orifices for perfect gas flow and clean, sharp kerfs.

Long control lever, equipped with exclusive *packless* valve. Gives positive smooth control even at lowest rates of flow. Pre-heat gases are blended in tip.



TORCHWELD 36-2

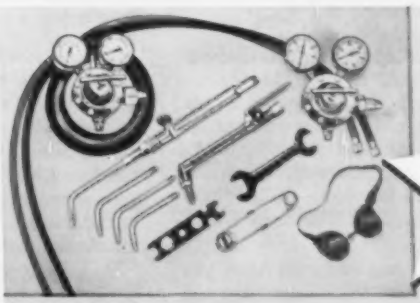
SPECIAL CUTTING TORCH FOR WIDE RANGE OF GASES

A medium pressure pre-mix type cutting torch designed for use with propane, butane, natural gas and city gas as well as acetylene. A fast economical cutter, its capacity ranges up to 16 inch sections.

Top or bottom lever, 75° or 90° forged bronze head. New packless type valve, far outlasts conventional types. Better control and smoother flow of cutting oxygen. Universal type silicon-bronze mixer. Precisely blends preheat gases through entire range of tip sizes. Nickel-alloy tubes, silver-brazed to head and body. Rugged, heavy-duty brass handle, grooved for sure grip and control.

SOD-R-BRAZE® ACETYLENE-AIR TORCH

An efficient, economical soldering, heating and light brazing torch . . . perfect for plumbing, refrigeration, automotive, electrical, maintenance and repair work. Three-way thumb control. Operator turns on and off, adjusts flame and sets pilot light—all with a flip of the thumb. Tips have individual mixers. 6 different sizes for a wide range of work.



TORCHWELD READY-TO-USE OUTFITS

A wide range of ready-to-use complete outfits for every welding and cutting need in every type of shop or plant. All needed accessories are included. Outfits cost less than the total price of components when bought separately.

TORCHWELD CUTTING ATTACHMENTS

Cutting attachments are available to convert each welding torch into an efficient, highly productive cutting torch. Doubles the usefulness of your welding torch.

Do every grinding job better

From lightest to heaviest work, Norton wheels bring you the profit-boosting "Touch of Gold"

STRAIGHT - CUP - CONE WHEELS

Straight Wheel makes short work of smoothing a heavy weld.

Flaring Cup Wheel, weld grinding a fabricated structure, saves time and work.

Cone Wheel is easier to use in hard-to-reach spots like this.

REINFORCED WHEELS - DEPRESSED CENTER

The Rigid BD Type is ideal for heavier weld grinding, smoothing flame-cut edges, slotting, notching, cutting-off, etc. Reinforced with glass cloth and Nylon.

The Semi-Flexible BFR Type excels in light weld grinding, removing scale, blending contours, scarfing and beveling before welding. Reinforced with cotton fabric and Nylon.

Norton portable wheels include all standard types, as well as the increasingly popular reinforced types. All are engineered for maximum strength, safety and versatility. All are built to *hug that work*, with less vibration and bounce — plus time-and-money-saving "Touch of Gold" advantages.

In straight, cup and cone types you can get 44 ALUNDUM abrasive and the B-11 resinoid bond. "44" is non-premium priced, cutting faster, grinding cooler and lasting longer than similarly priced aluminum oxide abrasives. B-11 resinoid wheels are more uniform in structure, better balanced, made to closest duplication and available in half-grade increments across the entire hardness scale.*

Among the various Norton reinforced wheels, the rigid BD and semi-flexible BFR are an unbeatable team for usefulness. Separately, each handles many grinding jobs. Together, they cover an almost endless list of applications.

Ask your Norton Distributor how these fast, tough wheels can benefit every grinding job you do. Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

W-1832

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON
ABRASIVES
Making better products . . . to make your products better

NORTON PRODUCTS
Abrasives • Grinding Wheels
Grinding Machines • Refractories
BEHR-MANNING DIVISION
Coated Abrasives • Sharpening Stones
Pressure-Sensitive Tapes

ANNOUNCEMENT

FOR THE ULTIMATE IN HIGH-SPEED LOW-COST ARC WELDING SEE THE NEW "LC" WELDING SYSTEM IN OPERATION AT BOOTH NO. 209

PREPARES ..... *the way for a new era in welding economy with the conventional flux-covered electrode process.*

PROVIDES ..... *welding speeds unsurpassed even with semi-automatic welding methods.*

DEPOSITS ..... *conventional flux-covered electrodes at speeds of 15 to 25 pounds per hour.*

ELIMINATES ... *special type power driven electrode feeding machines, special type welding materials, and special operating techniques.*

COSTS ..... *less to buy and less to apply at savings of 10 to 50%*

Seeing the new "LC" Welding System in operation alone will be well worth your trip to the St. Louis Welding Show.

Pioneer for Modern Welding

BERNARD WELDING EQUIPMENT CO. 10232 SO. AVENUE "N" CHICAGO, ILLINOIS

Less than 1% rejection by X-ray

with

ATOM·ARC 7016

ALL POSITION IRON POWDER LOW HYDROGEN ELECTRODES

AT

KAISER STEEL CORPORATION
Fabricating Division
Montebello, Calif.

Because of the size and weight (approx. 13.3 tons each) many of the welds were made in the vertical position.

Kaiser Steel Corporation recently completed six large missile test stands, portions of which are shown in these photographs. Except for a few minor members, the frames of these test stands were fabricated from plate material ranging in thickness from 1¼ inches to 3 inches. Atom·Arc 7016 electrodes were selected for all manual welds because of the quality of weld metal, efficiency, and out of position characteristics of this electrode.

All butt welds were required to be of radiographic quality, and in all six frames Kaiser experienced a rejection rate of less than one percent.

Atom·Arc iron powder low hydrogen electrodes for welding mild and low alloy high tensile steels have provided savings for many of the nation's leading fabricators through greater operating efficiency and superior quality weld metal.

For a complete set of data sheets write requesting Bulletin AR-8-2; Alloy Rods Company, P. O. Box 1828, York, Penna.

Alloy Rods Company

YORK, PENNSYLVANIA • EL SEGUNDO, CALIFORNIA

NO FINER ELECTRODES MADE . . . ANYWHERE

ANYWHERE A MAN CAN GO
THE NEW AIRCOMATIC® MIGet CAN WELD

Aircomatic MIGet Welding Gun and Control Panel. MIGet, 200 amperes, air cooled, handles one-pound reel of aluminum wire 3/64" to 1/16" and two-pound reel of hard wire .030" and 3/64" dia.

- **welds all weldable metals**
- **carries its own reel of wire**
- **operates up to 50 feet from control panel —with control panel 100 yards from power supply**

The new Aircomatic MIGet now makes it possible to weld practically anywhere a man can reach, climb or crawl.

The MIGet features its own compact, built-in reel of wire, high portability and overall light weight. Components of both the Aircomatic MIGet gun and Aircomatic MIGet Control Panel are miniaturized and simplified with sub-assemblies packaged to be replaceable as units.

Your welder may not be working in a crow's nest, but if the job is hard to reach, he'll reach it more easily than ever before and do the job faster with a new Aircomatic MIGet in hand.

Send today for technical literature on the Aircomatic MIGet. Or call your nearest Air Reduction Sales Office.

SEE IT AT THE AWS WELDING SHOW

AIRCO®

Offices and dealers in most principal cities

AIR REDUCTION SALES COMPANY

A division of Air Reduction Company, Incorporated
150 East 42nd Street, New York 17, N. Y.

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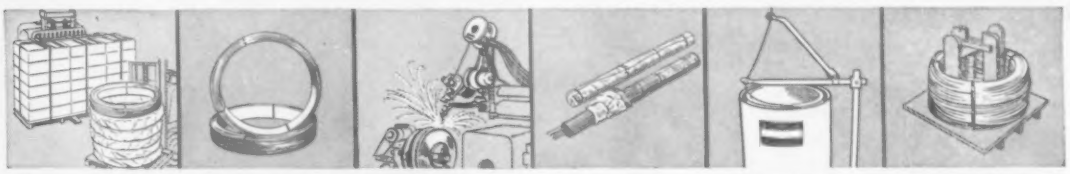
AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT • Products of the divisions of Air Reduction Company, Incorporated, include: **AIRCO** – industrial gases, welding and cutting equipment, and acetylenic chemicals • **PURECO** – carbon dioxide – gaseous, liquid, solid ("DRY-ICE") • **OHIO** – medical gases and hospital equipment • **NATIONAL CARBIDE** – pipeline acetylene and calcium carbide • **COLTON** – polyvinyl acetate, alcohols, and other synthetic resins.

PAGE Welding Wire

The RIGHT Packaging for the RIGHT Wire

• When you choose PAGE Welding Wire, you are assured of getting the exact wire for your application—and receiving it packaged to provide maximum protection and convenience. PAGE has developed a packaging program to cover practically every requirement in the broad fields of automatic, semi-automatic and manual welding. Coils, reels, bundles, cartons, Leverpaks, Payoffpaks, Payoffpallets... PAGE has them all! Look to PAGE for the *right* packaging of the *right* wire.



Wrapped Coils—Coils in Cartons | Welding Wire in Coils | Handy Reels | Gas Rod Packing | Payoffpaks and Leverpaks | Payoffpallets

This Chart Shows How PAGE Offers The Exact Packaging You Want

PACKAGING ↓ PAGE WIRE for →	Gas-shielded consumable electrodes: Automatic Welding	Gas-shielded consumable electrodes: Semi-Automatic Welding	Filler wire for automatic or manual Inert Gas Welding	Submerged Arc Welding	Straight and cut lengths Bare wire: Manual Electric Welding	Straight and cut lengths Bare wire: Oxy-acetylene Welding
25-lb. or 60-lb. coils wrapped in waterproof paper, steel-strapped, single or palletized.	✓	✓	✓	✓		
25-lb. or 60-lb. coils in individual cartons, single or palletized.	✓	✓	✓	✓		
120 or 180 lb. (22″/24″ I.D.) coils, paper-and-burlap wrapped, or in cartons, palletized.	✓			✓		
Special coil sizes (on application).	✓	✓	✓	✓		
25-lb. reels (spools) in carton to fit all standard machines; single or palletized.	✓	✓	✓	✓		
Leverpaks, 15″ dia., 25-lb. coils (12″ I.D.x2½″ wide); Leverpaks, 17″ dia. 50/60-lb. coils (12″ I.D.x4″ wide).	✓	✓	✓	✓		
Payoffpaks: 20″ dia. size holds up to 500 lbs.; 23″ dia. size holds up to 700 lbs.	✓	✓		✓		
Payoffpallets, holding 900-1200 lbs. of wire (3/16″ to 3/8″ sizes, incl.) coiled around pedestal on a wooden pallet.				✓		
Paper-and-burlap wrapped bundles, containing 50 lbs. of rods in 36″ lengths.			✓			✓
Fibreboard cartons, containing 10 lbs. of rods in 36″ lengths; single or boxed. 50# and over.			✓			✓
Burlap-wrapped 50-lb. bundles of bare wire electrodes in 14″ and 18″ lengths.			✓		✓	

33 DIFFERENT ANALYSES

PAGE covers the field of applications with *33 different analyses:* heavy automatic submerged arc..light manual submerged..inert gas manual...automatic, tungsten or metal arc, and oxy-acetylene gas welding.

Look to PAGE for your needs for automatic welding wire, gas welding rods, bare electrodes or metal spray wire.

PROMPT DELIVERY FROM LOCAL STOCKS

PAGE welding wire and rods are available from your nearby PAGE Distributor or PAGE warehouse stocks (*see list at right*).

Send for These...

- **Folder DH-402A** PAGE Submerged Arc and Inert Gas Welding Wire
- **Booklet DH-1277** PAGE Gas Welding Rods
- **Welding Rod Comparison Chart**

Page Steel and Wire Division
AMERICAN CHAIN & CABLE

ACCO

Monessen, Pa.*, Atlanta, Chicago*, Denver*, Detroit, Houston* Los Angeles*, New York, Philadelphia*, Portland, Ore. San Francisco*, Bridgeport, Conn.

*Indicates PAGE warehouse stocks

ACCO for Better Values

Technical Welding Data:
USS "T-1" Constructional Alloy Steel

2. How to weld

USS "T-1" Steel can be welded by any of the following processes:

1. **Shielded metal arc (covered electrodes)**
2. **Submerged arc**
3. **Inert-gas-shielded arc**

The thermal cycle of these processes does not harm the unusual physical properties of this quenched and tempered constructional alloy steel. Other welding processes which subject the steel to prolonged heating, with a resultant slower cooling rate, should not be used with USS "T-1" Steel without first establishing the suitability of the process.

SHIELDED METAL-ARC WELDING. Low-hydrogen electrodes of the E-9015 and E-9016 to the E-12015 and E-12016 classifications should be used to weld USS "T-1" Steel. (Suitable low-hydrogen iron powder electrodes of the same strength range are now available.)

To develop 100% joint efficiency, even with reinforcements removed, electrodes of the E-120 class should be used. Lesser, but often adequate, efficiencies can be obtained with electrodes of lower classification.

If a weldment must be stress-relieved, Nickel-Molybdenum-Vanadium type electrodes must not be used because the heat of stress-relieving, while it does not affect the steel itself, does reduce the toughness of the weld metal.

When welding USS "T-1" Steel to other types of steel, use low-hydrogen electrodes of strengths suitable for the other steel. Remember that weld metals under these conditions develop greater yield and ultimate strengths because admixing of elements from the USS "T-1" Steel enriches their usual chemical compositions.

SUBMERGED-ARC WELDING. Since the currents used in this process are often higher than those used in hand welding, extra care should be taken when welding USS "T-1" Steel to prevent excessive heat input to the base metal. Use multipass welding wherever possible and keep the heat input per inch below that generally used with manual welding.

When you weld USS "T-1" Steel by the submerged-arc process, perform preliminary tests to determine the optimum speed, voltage, amperage, and other welding conditions for the various thicknesses involved before you start welding the finished work. Don't use semi-automatic submerged-arc welding, in which the welding speed is controlled manually, unless you can maintain good control of the speed and, hence, of the heat input.

INERT-GAS-SHIELDED ARC WELDING. Some USS "T-1" Steel weldments have been made by this process with satisfactory results. In these instances, when Nickel-Molybdenum-Vanadium electrodes were used, the weld metal deposited had properties very similar to those obtained with covered electrodes of the Nickel-Molybdenum type.

REMEMBER THIS: In what other alloy plate steel would you find the combination of properties that "T-1" Steel possesses? Here, in just one steel, you get very high yield strength (90,000 psi minimum), extraordinary toughness, great resistance to impact abrasion, and good high temperature strength. These let you reduce the size of highly stressed parts . . . save weight, reduce the amount of welding required, and cut your costs. USS "T-1" Steel is being used in bridges, excavating equipment, pressure vessels, towers . . . in equipment that must take heavy abuse in sub-freezing temperatures . . . in equipment that must withstand heavy stresses and impact abrasion at temperatures as high as 600° F.

WRITE FOR COMPLETE INFORMATION about the application and fabrication of USS "T-1" Steel, United States Steel, Room 5604, 525 William Penn Place, Pittsburgh 30, Pa.

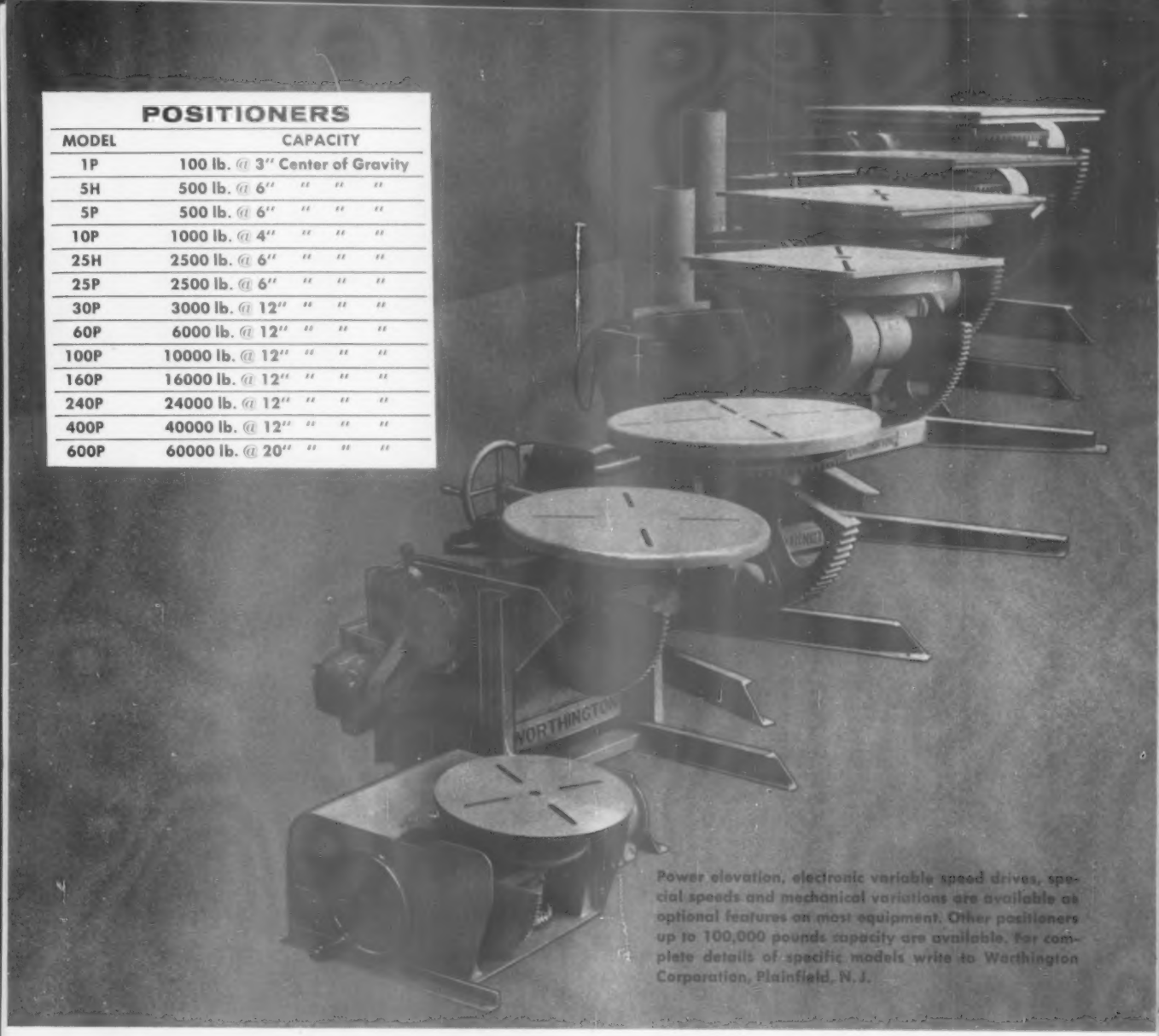
United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Warehouse Distributors
United States Steel Export Company

USS United States Steel

USS and "T-1" are registered trademarks

POSITIONERS

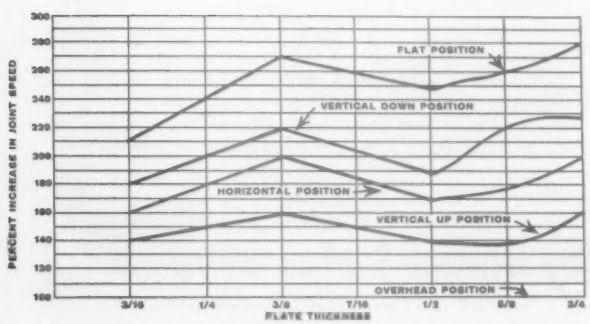
MODEL	CAPACITY
1P	100 lb. @ 3" Center of Gravity
5H	500 lb. @ 6" " " "
5P	500 lb. @ 6" " " "
10P	1000 lb. @ 4" " " "
25H	2500 lb. @ 6" " " "
25P	2500 lb. @ 6" " " "
30P	3000 lb. @ 12" " " "
60P	6000 lb. @ 12" " " "
100P	10000 lb. @ 12" " " "
160P	16000 lb. @ 12" " " "
240P	24000 lb. @ 12" " " "
400P	40000 lb. @ 12" " " "
600P	60000 lb. @ 20" " " "



Power elevation, electronic variable speed drives, special speeds and mechanical variations are available as optional features on most equipment. Other positioners up to 100,000 pounds capacity are available. For complete details of specific models write to Worthington Corporation, Plainfield, N. J.

INCREASE WELDING

with positioning equipment from



With a positioner you can often drastically reduce the cost of welding and work handling operations.

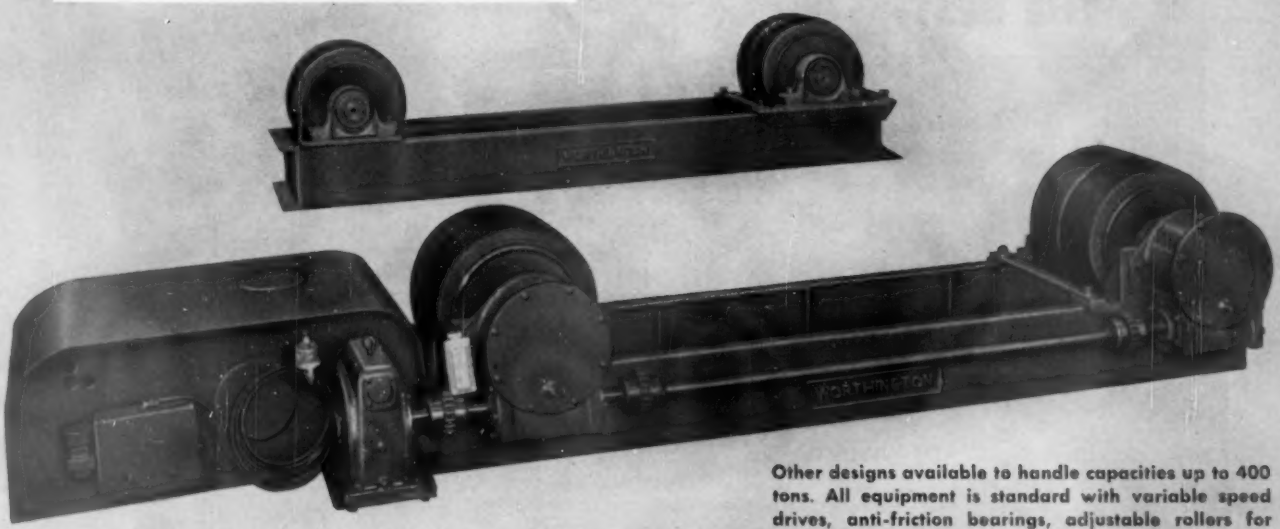
As the chart shows, joint speed in the downhand position is up to 280% faster than the other positions. With a positioner you always weld "downhand." Without a positioner it often takes more time and labor to handle the weldment than it does to actually weld the piece.

WHY WORTHINGTON?

There are many reasons why more welding is done on Worthington positioners than all others combined. One is

TURNING ROLLS

MODEL	TURNING CAPACITY		WEIGHT CAPACITY PER UNIT	
	METAL ROLLERS	RUBBER ROLLERS	METAL ROLLERS	RUBBER ROLLERS
A	9 tons	6 tons	3½ tons	2 tons
AA	10 tons	10 tons	5 tons	3⅓ tons
B	50 tons	30 tons	12½ tons	10 tons
C	100 tons	60 tons	20 tons	20 tons
D	180 tons	90 tons	30 tons	30 tons



Other designs available to handle capacities up to 400 tons. All equipment is standard with variable speed drives, anti-friction bearings, adjustable rollers for varying diameters, and electric remote push button for forward and reverse rotation. Optional features include tachometer and electric remote variable speed control.

Worthington turning rolls are also available in self-propelled models offering power driven and idler cars for power and idler rolls. For complete specifications write to Worthington Corporation, Plainfield, N.J.

SPEED UP TO 280%

Worthington's complete line

good service. With distributors in all principal cities a Worthington positioning specialist is nearby to help solve your welding problems.

Conservative ratings are another. Worthington engineers its positioners to deliver year after year the rating stamped on the nameplate. And Worthington brings the industry's broadest background of experience and know-how to bear on your positioning problems. Conceived in the fabricating shop of Ransome Machine Co.—later to become a division of Worthington—positioners were pioneered by Worthington people for more than 25 years.

Let us help you increase welding speed up to 280%. For descriptive information on Worthington's line of positioners, automatic welding head manipulators, turning rolls, and head and tailstocks, write to Section Y-76, Worthington Corporation, Plainfield, New Jersey.

WORTHINGTON

See Worthington at Booth 300, AWS Show, Kiel Auditorium, St. Louis, Mo.

STEEL HANDLE OR
WOOD HANDLE
ATLAS
GIVES YOU
THE BEST!
IT FITS THE HAND
Easier to Grip!
Safer!
FAMOUS ATLAS "DUAL TOOLS"
MODEL AW
MODEL B1W
JUST 2 OF 27 ATLAS MODELS
PROVED PRACTICAL ATLAS WELDING ACCESSORIES
Ask your welding supply dealer to show you the complete Atlas line. Atlas "Tomahawks" and "Dual Tools" are constructed to outlast ordinary weld cleaning tools and actually cost less in the long run. Welders like their "feel" and balance, turn out more and better work with less fatigue.
ATLAS WELDING ACCESSORIES CO.
707 E. LEWISTON AVENUE, FERNDALE 20 (DETROIT) MICH.

Letters should be addressed to: The Editor, WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill. No letter will be published unless signed, but your name will be withheld if requested.

Lady weldor

Milford, Conn.

Sir:

Our heartfelt thanks for your treatment of the story of our family and job shop in your February issue! We have been most immodestly drawing the attention of all and sundry to the article with the result that several of our customers requested copies. In addition, we must definitely save a couple of copies for future generations of Millers. Please send us ten copies. And, again, thank you kindly, sirs.

Anne Coleman Miller
Anne Coleman's Welding Shop

Welded structures

Youngstown, Ohio

Sir:

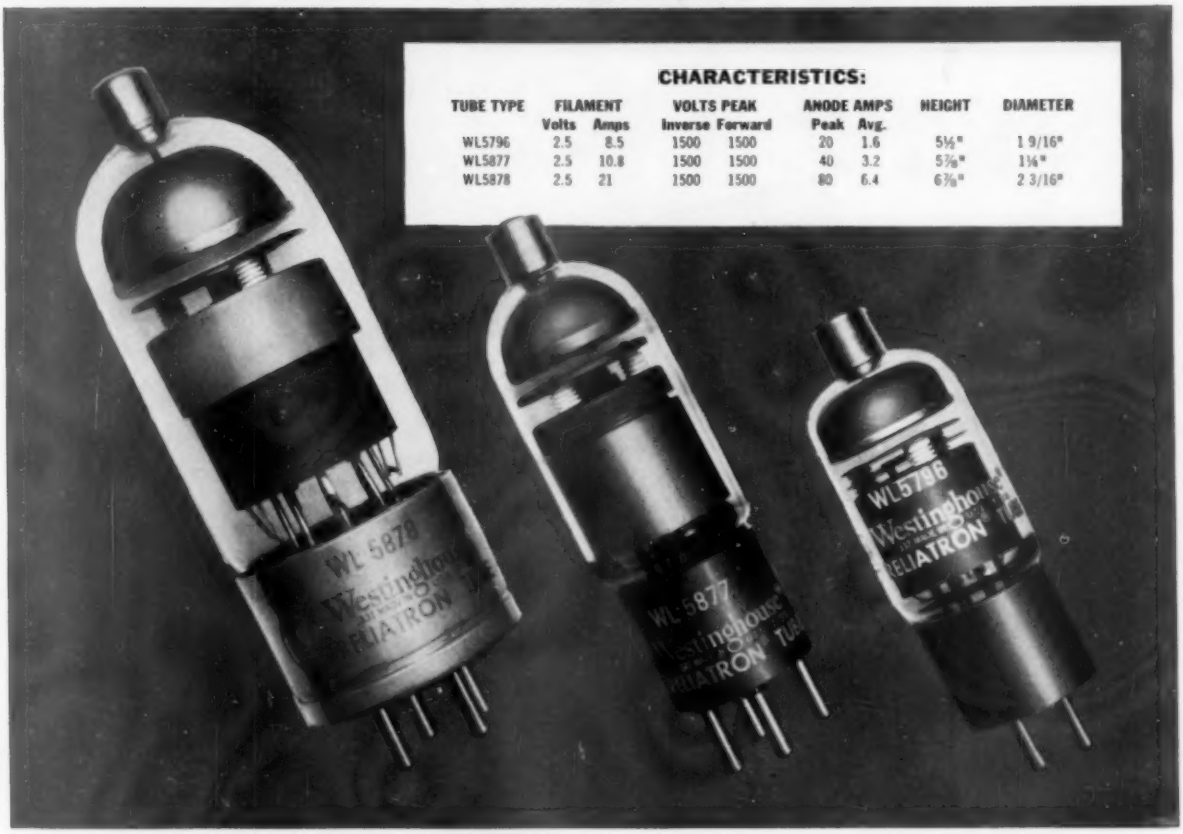
I wish to compliment Mr. Miller of Miller Electric Mfg. Co., on his letter in your February issue. I heartily agree with Mr. Miller's idea of welded structures. I feel that most engineers today are using, for the most part, designs used by our forefathers, thus adding cost plus more man hours per job.

Rivet structurals, plus castings, were ideal in our fathers' day, but now with changes being made so rapidly in the world, these rivet structures have become obsolete. We are fortunate to have the finest educators in the engineering field in this country. If our engineers would use steel plate design, enabling the use of press brake and welding, they could create machinery foremost in design and stability.

We still have, and will continue to have, structurals and castings, but if we are to advance we must begin to use formed plate design. Let's make our country advance by using more welding, thereby making our products more appealing to look at as well as giving them great stability. Welding is the cheapest, best and quickest method.

Joseph R. Kroly, Sr.,
McKay Machine Co.

New Xenon-filled Westinghouse THYRATRON TUBES IMPROVE welding equipment efficiency!


CHARACTERISTICS:
TUBE TYPE | FILAMENT Volts | FILAMENT Amps | VOLTS PEAK Inverse | VOLTS PEAK Forward | ANODE AMPS Peak | ANODE AMPS Avg. | HEIGHT | DIAMETER
WL5796 | 2.5 | 8.5 | 1500 | 1500 | 20 | 1.6 | 5½" | 1 9/16"
WL5877 | 2.5 | 10.8 | 1500 | 1500 | 40 | 3.2 | 5⅞" | 1¼"
WL5878 | 2.5 | 21 | 1500 | 1500 | 80 | 6.4 | 6⅞" | 2 3/16"
WL 5878
WL5877
WL5796

Compact new design saves space, gives superior performance and uniform quality!

If you are designing new welding equipment, you'll find new Westinghouse Xenon-filled Thyratrons the most advanced you can use.

CHECK THESE OUTSTANDING PERFORMANCE CHARACTERISTICS:

- 12 to 1 peak to average anode current rating.
- 1,500 volt forward and inverse voltage rating.
- 15 second averaging time.
- Operate in broad ambient temperature limits (-55° to 70°C).
- Fast cathode heating time.
- Small compact construction.

These new tubes will improve performance in existing equipment, too. Check your tube complements now to find replacement applications for Westinghouse Xenon-filled Thyratrons.

DIRECT INTERCHANGEABILITY

Westinghouse Type	Replacement For
WL5796	6478
WL5877	5544, 730
WL5878	5545, 6807, C6J, 5685, C6J/K, 760, 761, 6858

To learn how Westinghouse Thyratrons can fill your welding requirements, write today for detailed data. Westinghouse engineers will be glad to consult with you, if you wish. Sample orders available for immediate shipment.

CLIP AND MAIL COUPON NOW

COMMERCIAL ENG. DEPT., ELECTRONIC TUBE DIV.
WESTINGHOUSE ELECTRIC CORP., ELMIRA, N.Y.

Please send me full information on the following Thyratron Tube(s):

☐ WL5796 ☐ WL5877 ☐ WL5878

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

YOU CAN BE SURE...IF IT'S **Westinghouse** Electronic Tube Division Elmira, N. Y.

Here's a NEW WELDING TORCH that's WATERTIGHT... built for HEAVY-DUTY SERVICE ...yet weighs only 7 OUNCES!

This new HELIARC HW-18 Hand Welding Torch weighs only 7 ounces, making it easy for you to handle, less tiring. The special one-piece water cooling channel eliminates sources of leakage. And it's made for rugged, heavy-duty service.

YOU GET BETTER SHIELDING WITH LESS GAS

Improved design of collet body and closer electrode fit assure uniform argon flow, without jetting or turbulence.

GIVES YOU RUGGED SERVICE

Torch body is Fiberglas-reinforced phenolic for greater resistance to heat and thermal shock. Handle is tough, polished plastic. Gas cups have 4 times the impact strength of ordinary cups.

LEAKPROOF

Molded, one-piece water cooling passage has no joints to permit leakage—no water drip to contaminate welds.

◀ Diagram shows leakproof, one-piece water cooling passage in LINDE's new HELIARC HW-18 Hand Welding Torch.

EASY, MORE ECONOMICAL MAINTENANCE

Collets, collet bodies, cups and caps are interchangeable with those of your HW-17 Series 2 Torch. All couplings have standard IAA connections, and adaptors are included. Your production costs are lowered, too, for the new HW-18 saves time in hard-to-reach spots. Torch is designed for continuous 300-amp service, a-c or d-c.

ARGON SHUT-OFF VALVE

(Optional) saves time, steps and argon.

See and try this new HELIARC HW-18 Torch! For a demonstration, mail coupon today. Or call your distributor or nearest LINDE office. LINDE COMPANY, Division of Union Carbide Corporation. 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Dept. WE-4 LINDE COMPANY, Division of UCC
30 East 42nd Street, New York 17, N. Y.

Please advise me where and when I can examine and try out the new HELIARC HW-18 Hand Welding Torch.

NAME _____

COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

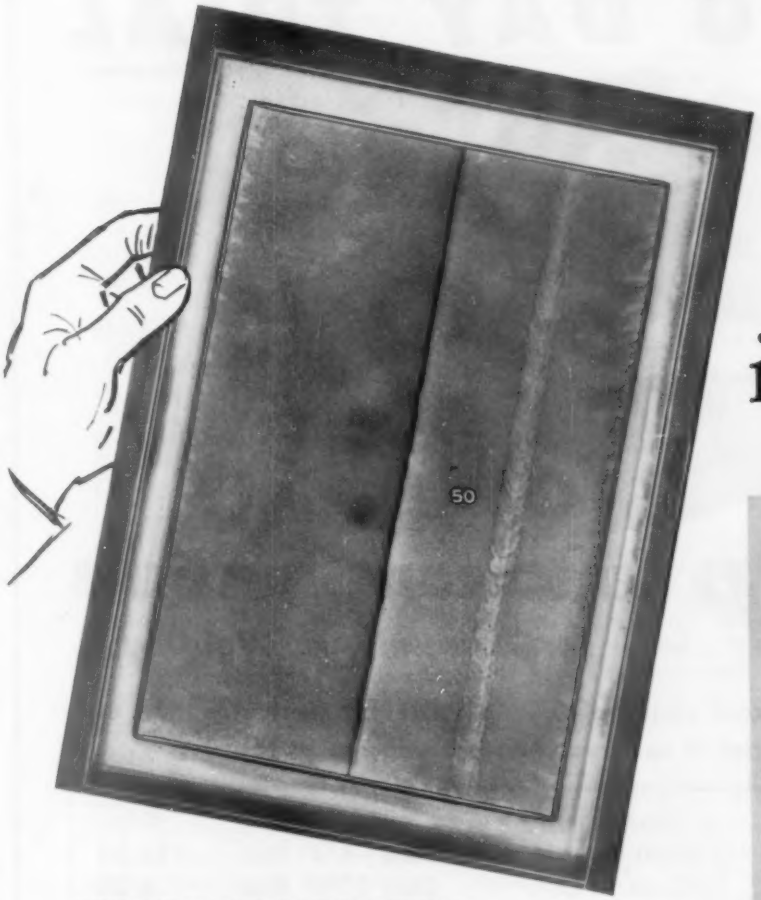
FOR THE BEST IN ELECTRIC WELDING LOOK TO Linde TRADE-MARK

UNION CARBIDE

The terms "Linde," "Heliarc," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

You're looking at a new, high-speed method of

100% x-ray inspection



XERORADIOGRAPHY

is almost as fast as fluoroscopy

...ends time and cost of x-ray film processing

If you want to perform 100% inspection of light-metal or thin-section ferrous components—xeroradiography (zero-radiography) is *the* preferred method. *Within one minute after exposure, you can view results* well within the accepted 2% sensitivity. Corrections can be made immediately after a flaw is detected.

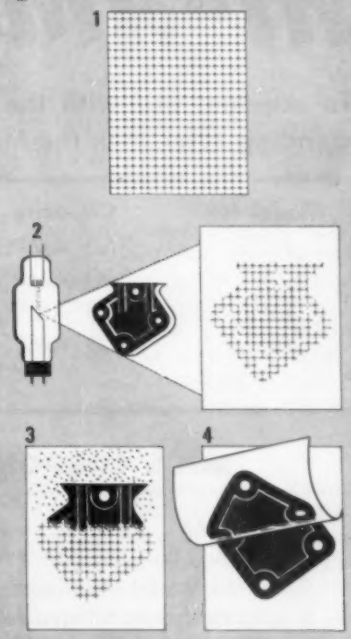
As for cost saving — xeroradiography requires a less expensive installation. There's no darkroom . . . no x-ray film. Metal plates are re-usable.

If you've been wanting to institute 100% x-ray inspection, General Electric now offers you a process that overcomes previous time and cost factors. Ask your G-E x-ray representative to demonstrate xeroradiography's possibilities for you. Or write X-Ray Department, General Electric Company, Milwaukee 1, Wisconsin, for Pub. AE-44.

Progress Is Our Most Important Product

GENERAL ELECTRIC

How xeroradiography process works...



1. Aluminum plate, coated with photo-sensitive selenium, receives positive charge which is lost when exposed to x-rays.

2. X-rays penetrate specimen as in conventional radiography. Charge on plate "leaks" away in direct proportion to the degree of x-radiation.

3. Negatively charged powder from spray gun adheres to positively charged area. Density varies with amount of charge. Image can be viewed directly, copied on film record, or transferred to paper.

4. Print can be made by pressing special paper on plate by rollers. Powder from plate is transferred, giving a positive image which is fixed permanently by applying heat. Plate is cleaned for re-use.

FREE 30 DAY TRIAL

HI-AMP ELECTRODE HOLDERS

For Manual Arc Welding

To acquaint you with the cool running, BALANCED FEEL, we make this outstanding offer. Pick the Model to suit your needs and write us today.

Model No.	Capacity	Description	Rod Size	Price
F-25	250 AMPS	Light Duty	Thru 1/4" Rod	$5.50
F3	300 AMPS	General Duty	Thru 5/16" Rod	6.00
LW3	300 AMPS	Light Weight	Thru 1/4" Rod	6.75
PI5	500 AMPS	Heavy Duty	Thru 5/16" Rod	8.00

Prices Lower in Quantities

MAIL COUPON! Use the best in Electrode Holders

Mr. Hi-AMP
Lenco, Inc., Box 189 Jackson, Missouri

Send me Model Number .... HI-AMP electrode holder for FREE 30 day trial. This is your authority to invoice me through the welding supply distributor listed below for the price of the model I have selected. If, after thirty days use, I am not entirely satisfied with the performance of this electrode holder, your distributor may pick it up without any obligation on my part.

Name..... Title.....

Company Address.....

Welding Distributor's name.....

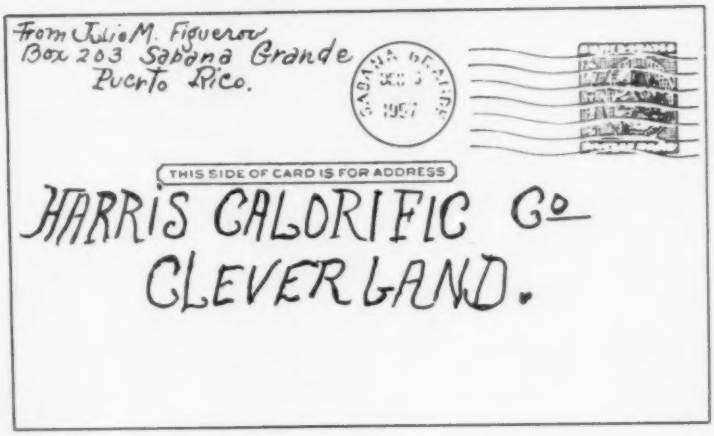
This offer good only until June 1, 1958. Subject to be withdrawn without notice.

LENCO, INC. • Box 189 • Jackson, Mo.

BETWEEN PASSES

Cleverland?

Score one for the U.S. Post Office—the post card reproduced here found its way to the addressee in Cleveland without difficulty. The correspondent, from Puerto Rico, sent the card to Harris Calorific Co., asking the address of its distributor in that Commonwealth.



too literal

Speaking of addresses, one of the wrappers on a foreign welding magazine which we get at our office now bears the legend WELDING ENGINEER, *Please change our address*, Box 28, Morton Grove, Ill. Seems the circulation department of that publication copied verbatim our instructions when we notified them of our move some months back.

complete coverage

. . . accurate coverage, timely coverage of the welding industry is our aim. To further that goal, WE instituted the *WeldWorld* page several years ago. Since that time, this WE "first" (among many others) has brought you exclusively the latest in new developments affecting our industry. We try immediately to follow up with more complete details. In this, our Welding Show Issue, we bring you a special section (pages 98 through 108) on new developments which were first announced last month in *WeldWorld*.

Our May issue will likewise contain full details on several other new processes. Watch for it.

science and culture

"It seems to be implied that science and mathematics have only a specialized interest, that they lack a cultural content. To me this is inane. The contribution that the study of mathematics makes to the mind, encouraging precision, the sense of the quantitative, has very broad importance to all living. In the 20th century, with the moon the next stop . . . with every branch of science beckoning us toward any number of goals, how can science be less educational in the broad sense, for all of living, than everything else?"

The above is an excerpt from a talk given early last month by Dr. Robert F. Mehl, director of metals research laboratory, head of the department of metallurgical engineering and dean of graduate studies at Carnegie Institute of Technology. We print it here because it so succinctly says what we, too, believe, and try to preach.

the industrial atom

If your firm is considering entering the atomic industry, an 84-page report just announced by the Atomic Industrial Forum should be of interest to you. "Growth survey of the atomic industry, 1958-1968" has been developed as a guide to organizations that wish to undertake various market studies in the field. For those already in the industry, it will help measure their own business estimates against a composite estimate for the whole.

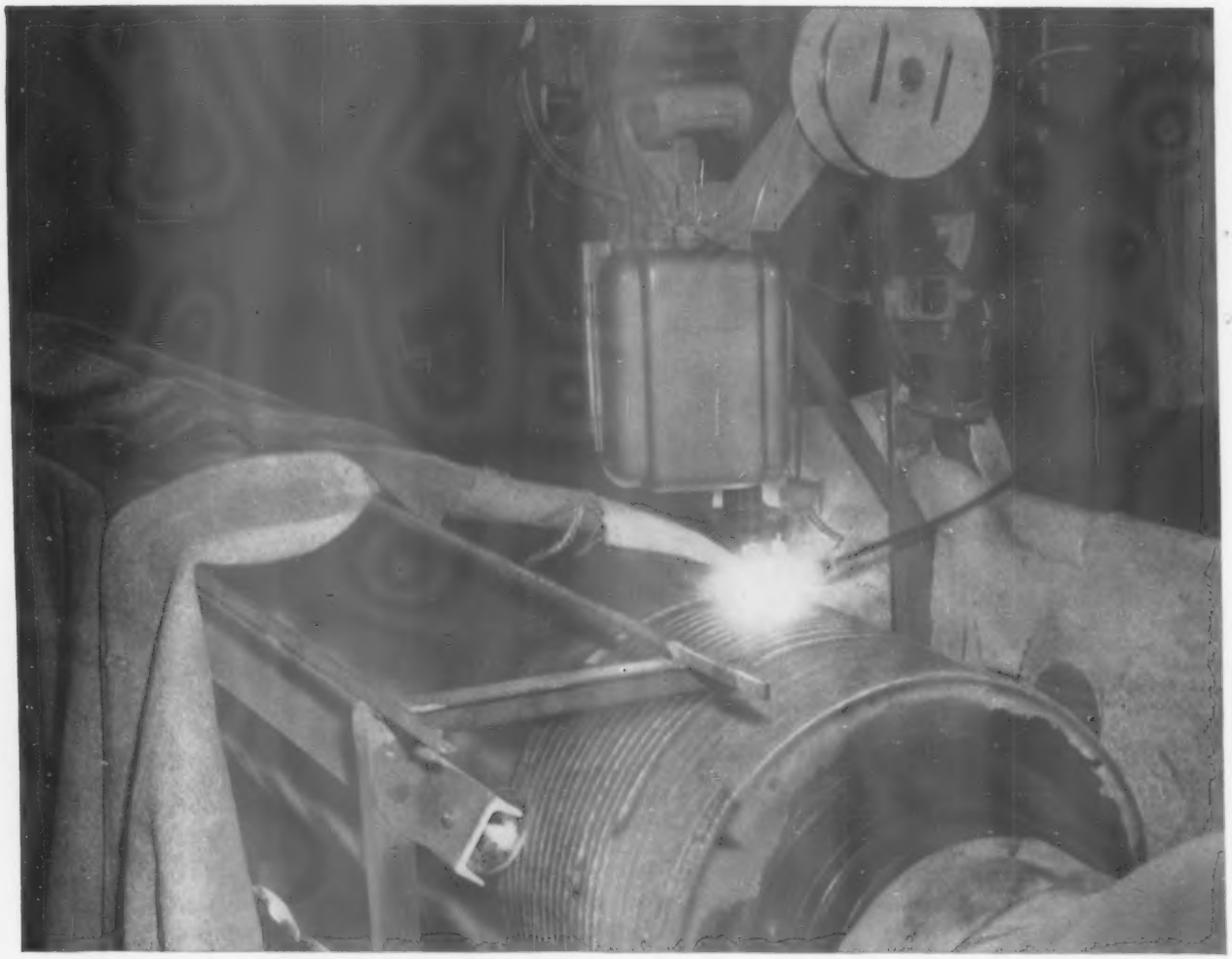
Copies of the report cost $25 each and may be ordered from Atomic Industrial Forum, 3 E. 54th St., New York 22, N.Y.

welded boats

Shipbuilders have long recognized the value of welding . . . but until recently little, if any, welding was used in fabricating smaller pleasure craft. But the switch is on.

Starting on page 42 of this issue, an article gives details on construction of a famous welded aluminum yawl. Not too many months ago, we wrote about welded steel houseboats. Now another big name in the pleasure boat industry has turned to welded steel. Chris-Craft, long identified with wooden vessels, has set up a division, Roamer Steel Boats, which will manufacture a completely new and restyled line. We hope to bring you welding details in the near future.

GENERAL view of exhibit room at New York Coliseum where members of press gathered Feb. 26-27 for unveiling of A. O. Smith's new multi-arc distribution system from one power source. Press party was sponsored by Smith and J. B. Nottingham & Co. See page 100 of this issue.



Sigma HW-13 torch and "61" Nickel wire are positioned over cast iron Kamyr press roll. Prior to welding, rolls are machined to remove all grooves and pre-heated to 250°F with twenty-six 250-watt lamps. Asbestos blankets hold heat in. During welding, rolls are rotated at surface speed of 9 inches per minute, while a blanket of 99.995% pure argon gas prevents atmospheric contamination of the weld zone. Carriage speed: one inch per revolution; oscillation width: 1 1/8 inches with weld overlap of 1/8 inch; current: 350 amps, 35 volts, DCRP. Cold wire is added to increase deposition while decreasing penetration.

Inert gas overlaying of cast iron saves Brunswick $43,200

Replacing a $20,000 set of cast iron press rolls every six months or less was becoming a major headache at Brunswick Pulp and Paper Company.

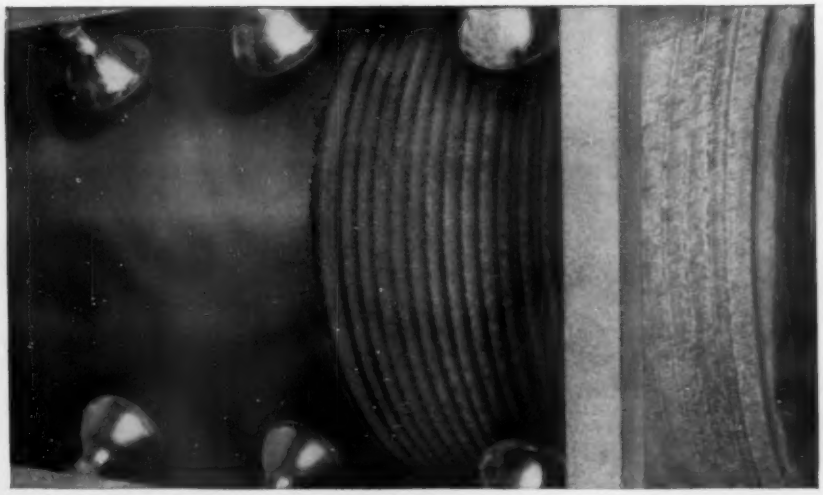
The sulfur dioxide solution they use to protect the color of the pulp was attacking the grooves in the rolls causing corrosion and pitting. Pulp would adhere to the rolls and become stained. Paper breaks became frequent.

With downtime costing them $600 an hour, a way had to be found to bring costs into line.

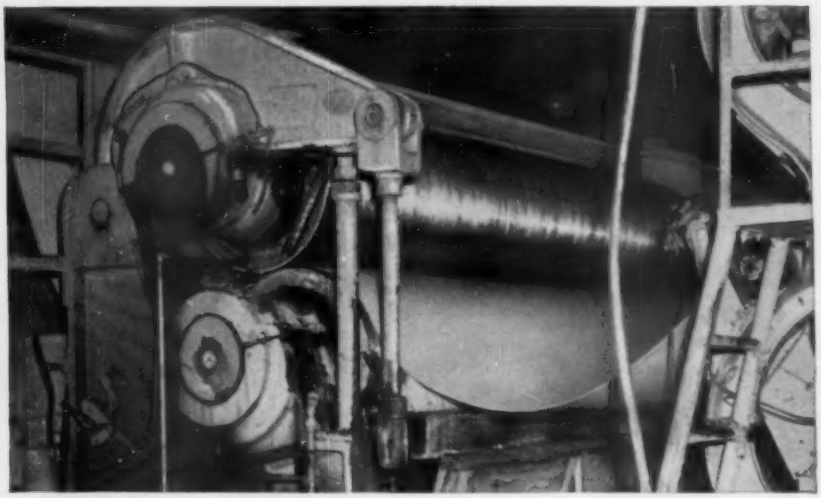
After experimenting with various methods, Brunswick decided on overlaying the press rolls with Nickel. Using the Sigma* welding process and Inco "61"® Nickel filler wire, they resurfaced a set of rolls for less than half the cost of replacement set.

Today, nearly three years later, this same set of rolls is still in regular use – still in excellent condition.

INCO WELDING
electrodes • wires



Here you see the high quality of nickel overlay. Brunswick engineers choose Nickel because of its resistance to corrosion and chipping.



Back on the job, roll lasts three years and longer (compared to six months for rolls not resurfaced with Nickel) saving $43,200 annually in downtime.

*Sigma Welding is a process of Linde Company, Division of Union Carbide Corporation.

®Registered trademark of the International Nickel Company, Inc.

rolls with Inco "61" Nickel filler wire each year in maintenance costs!

By eliminating downtime for changing rolls on this and two other sets that have since been resurfaced with "61" Nickel filler wire, Brunswick now saves a total of $43,200 a year.

When you want fast, high-quality welds in overlay work or in straight fabrication by the inert gas process, take a tip from Brunswick. Try Inco's "Sixty" series of filler wires. Their controlled composition gives you sound, ductile, corrosion-resistant welds.

For detailed information on welding nickel alloys, cast irons, and dissimilar alloy combinations, send for "Inco Welding Materials." It gives you a complete list of Inco Welding Products and recommendations for their use.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO

PRODUCTS
• fluxes

Underneath the handsome bead of a well worked weld, catastrophe is often hidden. Catastrophe that means the possible loss of millions of dollars in man hours and materials should a flaw go undetected.

And the detection of flaws in welds through X-ray is a process that depends on human inspection to properly interpret the delicate tones deposited on X-ray films. That's why a film that gives strong gradation of even the subtlest imperfections makes the job of detection easier and surer.

Ansco X-ray films ***have*** the necessary characteristics for this crucial work. That's because Ansco films are designed especially for this purpose. Higher speed, greater contrast, easier to read means money saved on inspection jobs. Ansco X-ray films are actually more economical because of this. The best you can get is Ansco, and the best is what you must depend on to reveal a possible "hidden catastrophe."

Ansco, Binghamton, New York. A Division of General Aniline & Film Corporation.

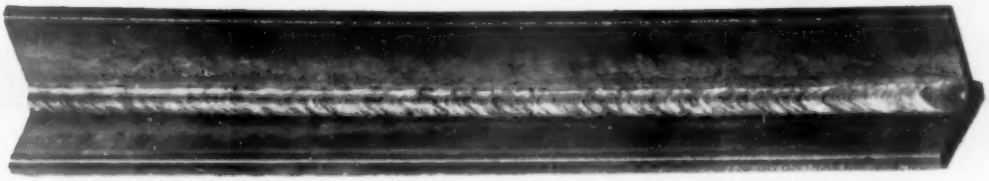
Hidden Catastrophe

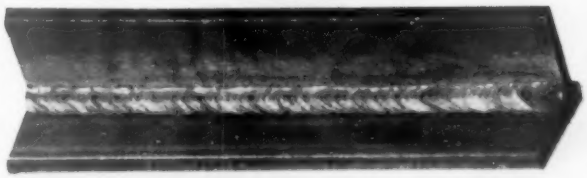
Ansco

Industrial X-ray

Now . . . another dramatic advance in electrodes

from **AIR REDUCTION . . .**





Over 90% Bonus!

This is the extra weld per rod you get with the new Airco Easyarc Stainless steel electrode

This is what you get with the conventional electrode

A NEW LOW-COST ELECTRODE FOR STAINLESS STEEL

New Airco Easyarc stainless steel electrodes produce over 90% more weld per rod . . . actually cost 29% less per pound than conventional stainless steel electrodes!

The new Airco Easyarc stainless steel electrodes are the first powdered-metal electrodes for stainless steel ever offered! They make possible *tremendous savings,* opening up possibilities for stainless use in many *new applications.*

You can weld practically *any* type of stainless steel with the new series. They are available as Easyarc 308, 316, or 347, the designations being equivalent to the type of stainless they weld. Restriking is instantaneous. Available in sizes from 3/32" to 3/16".

Order the new Easyarc stainless steel electrodes from your nearest Authorized Airco Dealer. Look for his name in the classified section of the telephone book under "Welding equipment and supplies." Or call your nearest Airco office.

welding
AT THE FRONTIERS OF PROGRESS YOU'LL FIND . . .

AIRCO

Offices and dealers in most principal cities

AIR REDUCTION SALES COMPANY

A division of Air Reduction Company, Incorporated
150 East 42nd Street, New York 17, N. Y.

SEE IT AT THE WELDING SHOW

On the west coast — Air Reduction Pacific Company

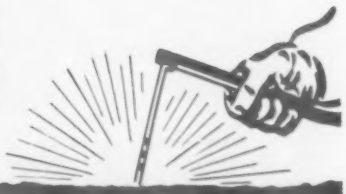
Internationally — Airco Company International

In Cuba — Cuban Air Products Corporation

In Canada — Air Reduction Canada Limited

Products of the divisions of Air Reduction Company, Incorporated, include: **AIRCO** – industrial gases, welding and cutting equipment, and acetylenic chemicals • **PURECO** – carbon dioxide – gaseous, liquid, solid ("DRY-ICE") • **OHIO** – medical gases and hospital equipment • **NATIONAL CARBIDE** – pipeline acetylene and calcium carbide • **COLTON** – polyvinyl acetate, alcohols, and other synthetic resins.

Weldynamics



ARC WELDING AT WORK CUTTING COSTS

WHY WELDORS AND MANAGEMENT LIKE IMPROVED FLEETWELD 47

Improved Fleetweld 47 gives that fast, easy operation . . . yet it isn't limited to the flat position.

Weldors appreciate the smooth flowing action!

Management loves the cost-cutting speed and versatility.

Try Improved Fleetweld 47 on your next flat and uphill production job. You'll love it too! It conforms to AWS E-6013 and E-6014.

Write for the *new* Weldirectory Bulletin 7000.1.

Lincoln men who know Weldynamics will help you establish procedures, select equipment and electrodes for most efficient, low-cost welding.

The World's Largest Manufacturer of Arc Welding Equipment

© 1958 The Lincoln Electric Company

THE LINCOLN ELECTRIC COMPANY, DEPT. 1740, CLEVELAND, OHIO

APRIL, 1958

Welding Engineer

ESTABLISHED 1916

Welds are not to blame!

"A rust-proof, chrome-plated handle—bolted, with no *welds* to break", reads a recent advertisement describing a product for consumer use. And it's a real slap in the face for welding.

Why? Apparently, we imagine, because sloppy welding or—more likely—poor design caused this product to break at some time in the past—much to the dismay of customers and firm. They will now see to it that such a dilemma never arises again, and not only have they eliminated welding in their plant, but they will continue to take verbal pokes at it in their ads.

We often wonder just how many weldors, technicians, engineers and designers ever stop to consider the fact that a careless act on their part could eventually put them—and their firms—out of business.

Small mistakes don't have to be repeated very often to "un-sell" a customer. And once unsold, he will be a difficult man to bring back into the fold.

Have there been weld failures on jobs performed recently in your shop? If so, do you know *why* they failed? This is not an academic question; one of the most important pieces of information you could possess would be the exact reason for a weld failure! It's important for reasons of building better products. It's equally important for your personal use in helping to keep welding's good name intact.

THE OLD, OLD problem of design comes pretty vividly to light when welded products are returned for welded repairs . . . then have to be brought back a second time. The repair weld broke. This isn't coincidence. Chances are, the part hasn't been designed properly and won't withstand stresses set up on the job it must do.

But once you have determined this fact, what do you do? It's a cinch that you're not going to sit and watch repair bills soar. And it's equally certain that you don't want your customer to leave with the impression that welding is the fly in his ointment.

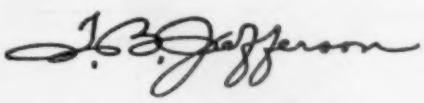
Here's one course of action you might take: (1) Explain immediately to the customer that welding can't work miracles when designers fall down on the job. He'll probably calm down and agree with you once he knows the facts. So you've probably saved your reputation—but only for the moment! You must then (2) get cracking on the design problem and see to it that weaknesses are quickly ironed out of the product.

WHEN YOU TACKLE Part 2 in this attack on poor design methods, you may be in for a surprise. You may find, for instance, that in the blueprint stage, "design" of your product simply means writing the word "weld" on the plans and drawing in a few rough arrows. This is the situation which shop men must face at times—and for which they must take the blame.

If it's a situation like this that you encounter, do your share to improve communications, and help take design problems out of the shop. Put them back in the engineering department where they belong.

It's obvious, of course, that shop weldors can't be let off the hook when they make bad welds—regardless of the poor quality of blueprints they receive. But don't blame them for part failure if their welds fail through no fault of their own.

Let's get to the root of the problem, and start to design *properly* for welding. Let's do what we can to retain our pride in welding. It shouldn't be a difficult task to accomplish—and it can bring each of us enjoyable rewards: for instance, the discontinuance of ads which can describe a product only as having "no welds to break."



This roller, hardfaced with Victoralloy, shows practically no wear after crushing 40 tons of rock hourly, 8 hours daily for 30 days.

HOW TO SAVE ON ROLLERS AND ROD

....*Use VICTOR Hardfacing*

Tracy Rock & Gravel Co., Tracy, Calif., crushes 40 tons of rock hourly, prolongs roller life on this rough work by rebuilding with 1/4" VICTORALLOY #1 Bare Electric rod, 28" length. Says plant superintendent Albert Parker:

> "Victoralloy's ease of application and fast buildup mean a lot to us. There is no lost time as we use 28" length rod; when it burns down, we touch a new rod to the old one, and keep on welding without even lifting the helmet."

You, too, can save rod and increase working life of crusher rolls, screens, shovel teeth, tractor rollers and idlers, dredge pumps and many other parts subjected to abrasion and severe impact. Simply hardface with VICTORALLOY. It welds to manganese, steel or cast iron. You get all position hardfacing, exceptional arc stability, deposits free of porosity, fast application without slag interference. Try it. Order a supply from your VICTOR dealer TODAY.

• FREE •

Victor Hardfacing Manual shows you right rod to use and how to apply it.

Write us NOW for your copy.

Profitable dealerships open; inquire now!

37 VICTOR for hardfacing

VICTOR EQUIPMENT COMPANY

ALLOY ROD AND METAL DIVISION

13808 E. Imperial Highway, Norwalk, Calif. • Wakita, Oklahoma

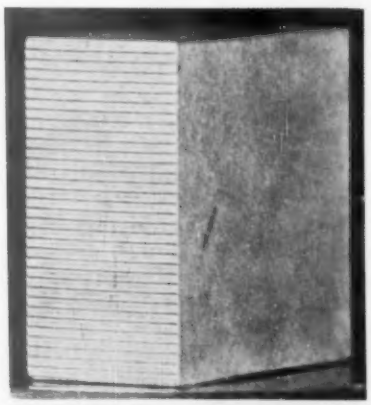
In resistance brazing thin sheets and large blocks

Knurling becomes a design criterion

By W. L. Hughes *and* L. E. Mills

IN COPPER-TO-BRASS brazing with high-silver alloys, needed electrical connection between power source and joint is provided by carbon block electrodes, which also furnish required positioning force.

Conduction from the carbon blocks transfers energy, bringing the joint to brazing temperature. Clearance of 0.002 to 0.003 in. between parts insures complete penetration of brazing alloy. Clean, properly fluxed surfaces are also necessary.



KNURLED brass block before flux is applied.

Brass blocks have been torch brazed to copper waveguide sections for some time. Waveguide distortion by stress relief and unequal heating, however, caused rework and scrap. Resistance brazing, because of its speed and localized heat, did not.

Because of size and mass ratios of parts, passing currents *through* the joint to concentrate and localize heat seemed best. But electric current breaks down standard silver brazing flux, and if the current is to pass through the joint, a means of isolating the flux must be developed.

Knurling Best

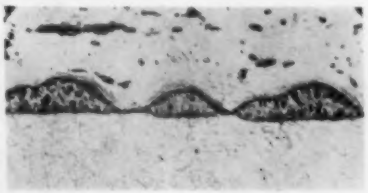
After attempts with brazing filler sheets of various alloy and thickness, the brass block was knurled to a depth of 0.005 in.

After liberally flux-coating and wiping the knurled surface, a sufficient amount of flux should be left in the groove root. The knurled surface is then placed against the copper sheet and clamped in position between two electrodes (No. 3 Morse taper Group A, Class 1) on a single-phase spot-welding machine.

The clean lands carry the current without flux electrolysis. The groove provides ideal clearance for 100% penetration of filler wire, preplaced or hand fed into the joint.

Shim Inserted

Brazing temperatures of 1,112 F were attained in the block center 15 seconds before the joint reached brazing temperature. Insertion of a shim between the copper sheet and electrode relocated the hot zone at the joint. The shim consisted of brass and copper sheets, each 1/16-in. thick, and a stainless steel sheet 0.040-in. thick.



CROSS section of knurled brass block copper sheet resistance brazed joint. Top, brass; center, flux; lower, copper.

Because of steel resistance, slight changes in thickness will make large changes in the hot zone position. It conducts the full current and creates an artificial hot zone below the joint. Heat is conducted through the copper shim to the copper sheet, increasing amperage-resistance loss in the block contact.

The brass shim adjacent to the electrode offers a poor conductive path from the steel sheet to the water-cooled electrode, adding to the electrical efficiency of the process.

RESISTANCE brazed knurled brass block to copper sheet joint before copper sheet sheared off in peel test.

Pulsation Weld

An electrode force of 50 psi with a current of 15,000 amp was used. The brazing period used 60 pulses of 30 cycles separated by a one-cycle cooling period. The machine was set at pulsation weld and repeat, using a weld no-weld switch to control current.

The knurling technique was also used in brazing ½-in.-diameter rigid copper tubing into a prepared socket on a large brass casting.

Tube expansion was more than the casting, prohibiting alloy penetration by taking up all joint clearance. Greater socket diameter with full 0.003-in. joint clearance caused cracks and fissures as the copper cooled.

The tubing was then knurled 0.003-in. deep with only a 0.001-in. clearance between lands and brass casting. While the tubing expanded, 50% clearance of the outer joint was maintained by the grooves. This process has not been fully evaluated yet.

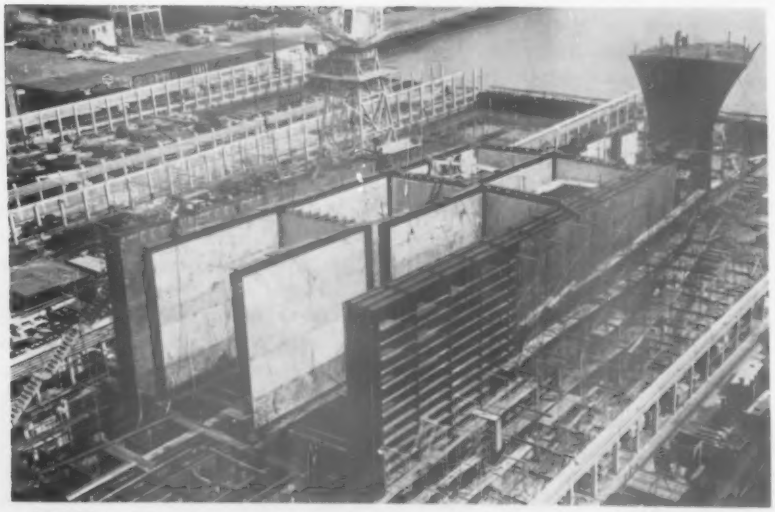
Knurling of one joint member has proved successful in initial trials in other brazing problems.

ALMOST ready to take on cargo and head for Houston and points east, *SS Angelo Petri* rides high in the water at its Stockton, Calif., dock.

California produces 90% of the 120,000,000 gal of wine drunk annually in the U. S. In the SS Angelo Petri's 26 welded tanks, 2,412,185 of these gallons can be transported in one trip from California to Gulf and east coast ports. The Petri is indeed . . .

A wine tanker with a "stainless" reputation for quality

By Philip Ferry



PROW is the only recognizable ship segment in this shot of early fabrication stages. In center, some of the ship's 26 tanks are taking shape.

WHEN THE *SS Angelo Petri* put into New York harbor one day last October to end its maiden voyage from California, 26 all-welded cargo tanks within the vessel's hull contained the first load of bulk wine ever carried by a U. S. ship constructed for that purpose.

The New York *Times* headlined the arrival this way:

First U. S. Wine Tanker Arrives in N. Y. With Load On

Apart from giving journalists an unavoidable opportunity for levity, however, the 21,800-ton *Angelo Petri* made a justifiable impression on the maritime industry. It is not only the *first* U. S. wine tanker; it is the *first* such vessel constructed anywhere in the world.

For years, French vintners have transported wine by ship. But these vessels are invariably modified tankers and cargo vessels. Further enhancing the new ship's value is the fact that it can carry other edible and potable liquids in addition to wine.

Not One—Two!

Most remarkable feature of the *Petri's* debut—that it is not *one* ship, but *two*—was left unmentioned in newspaper accounts of its maiden run. Angelo Petri is a new name, but less than half the ship is new. The stern section is the surviving half of a T-2 tanker that came apart in a storm off the Alaskan coast in 1946. When bow and midships went to the bottom, the stern section was salvaged and towed to Anchorage.

There it served as a source of municipal electric power for several years until it was purchased by United Vintners, Inc., and Petri Wine Co. of California early in 1956. Towed to the San Francisco yards of Bethlehem Pacific Coast Steel Corp., the half-hull was destined to be transformed into something new in maritime history.

The marine architectural firm of Michael Ryan & Assoc. was handed the task of designing the new vessel. Both Bethlehem and Ryan knew from the start that only modern welding techniques could make possible the resurrection of the once-rusty hulk.

Comments James Patterson, Bethlehem official in charge of welding: "Several welding processes were

used—manual metal-arc and automatic and semiautomatic submerged-arc for mild steel and type 316 stainless-clad materials. Tig (tungsten inert-gas) was employed on special products cargo piping—which was also type 316 stainless."

Gas and Machine

Clad plates were cut by oxyacetylene torches, which were machine-mounted wherever possible. A mechanical planer was brought into use on plate edges being prepared for welding.

The architects knew, of course, that all equipment parts which would contact the wine cargo (*e.g.*: tanks, pumps, pipelines, valves) would have to be resistant to mild acids and chemical corrosion. In addition, the 26 tanks would have to have rounded corners.

The metal which promised to meet all specifications was the weldable type 316 chromium-nickel stainless used in the piping and as cladding.

Continued Patterson: "While submerged-arc welding of various types of low-alloy and stainless steels is not unusual, we believe its application on stainless-clad steel is rather new—particularly where physical, chemical and corrosion-resistant properties must be maintained."

Ground Assembly

Both sides of all clad plates that went into the *Petri's* special products tanks were submerged-arc welded. After being assembled on the ground in special fixtures, the steel side was welded first, then the stainless. A type 310 wire and a glomerate flux containing 3½% molybdenum were used for the latter welds.

"The advisability of employing a flux with this moly content may seem questionable," Patterson admitted, "but its incorporation in the weld was necessary, in the final analysis, for joint soundness."

In an effort to control dilution on the stainless side—a factor of prime importance in maintaining corrosion-resistant qualities—the clad side of each plate was automatically gouged to a "slight depth" by the carbon-arc process.

Patterson expressed a feeling of "special pride" over the fact that the Bethlehem weldors achieved submerged-arc welds on the stainless that were "cathodic rather than anodic"—thereby retarding corrosion.

HEAVY flange is Tig welded to 6-in. stainless pipe with insert ring and inert-gas backing. Manual metal-arc process completed joint.

Insert Rings

In welding the 316 stainless piping, insert rings were extensively used. An inert-gas backing was also employed, and was held in place by plugs inside the pipe on either side of the joint. Tig guns were used to fuse the insert ring, then the metal-arc process with type 316 electrodes finished the joints.

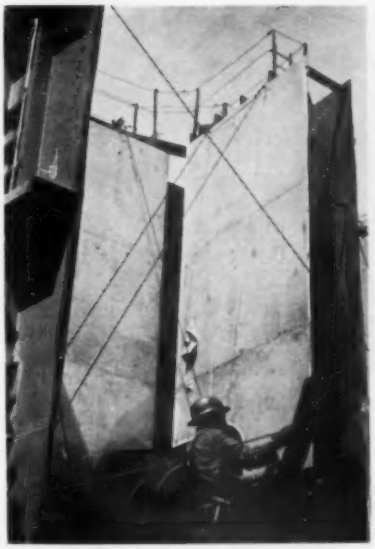
Practically all welds for the Petri's special products cargo piping were made in the Bethlehem shop, and only a few were necessary as the pipe was installed on shipboard.

Operating between its home port of Stockton, Calif., and the ports of Houston and Newark, the 529-ft *Angelo Petri* will actually carry a diversified cargo. There are, for instance, 14 wing tanks in addition to the 26 major storage tanks. On the ship's maiden voyage, these smaller tanks carried safflower oil to New York. Returning to California, the *Petri* crew pumped petroleum products into these same tanks.

(The 26 special products tanks are independent units and, as such, preclude any possibility of accidental product admixture. Coffer dams separating each tank guard against the danger of contamination due to leakage.)

Tank Cleaning

So that the ship may carry such products as beverage alcohol, industrial grain alcohol, commercial sugars in solution, corn syrup or edible soybean oil on its return trips through the Panama Canal, the tanks had to be easy to clean and sterilize. A chlorine solution handles the sterilization problem well, but evacuating residue from the bottom of the tanks posed an initial design problem.



BULKHEADS for *Petri's* cargo tanks are braced in position. Rounded corners and bottoms were then welded in, assuring thorough cleaning.

It was solved through the installation of a system which sprays water and steam under high pressure into the tanks. L. N. Bianchini, vice president of United Vintners, reports that "the tanks can be sterilized to the point where they could safely receive a highly perishable product like milk."

Bianchini also cited some of the principal reasons behind the Petri-UV move into the shipping business. "Petri's annual transportation bill for wine deliveries to Gulf and east coast distribution points was around $2,000,000—a substantial bite. There was also a recurring problem of oxidation (introduction of air into the wine cargo aboard tank cars.)

"*SS Angelo Petri* will undoubtedly cut transportation costs, and it promises profits on return cargoes. We'll have close control over the movement and distribution of our product, and the chances of oxidation will be markedly reduced."

Is the United Vintners Line satisfied with its new $9-million vessel? "Definitely," Bianchini states—and adds with a smile: "we've learned there are a lot of nice people in the shipbuilding industry!"

PORTABLE pencil spot welder is used for small amount of hand work required for final assembly.

Spot welding aids in solving aircraft weight problems . . .

By Bruce Mitchell
Ryan Aeronautical Co.

SUPERSONIC AIRCRAFT can be either 25% lighter or withstand aerodynamic heat of 750 F without added weight as result of a 3-year program of research in lightweight structure design by Ryan Aeronautical Co.

Honeycomb, foam, posts and closely spaced stiffeners were considered to gain strength and rigidity when using thin sheet. Although each is satisfactory from a stiffness and temperature standpoint, the weight was too great.

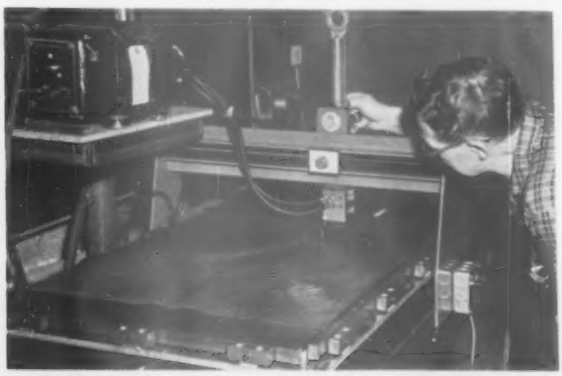
All joints, attachments and non-structural material, such as glue and excessive core material, add weight. For example, a single glue line is weight-equivalent to a sheet of aluminum 0.006-in. thick. Therefore, all factors were considered, tested and analyzed from a weight and strength-efficiency standpoint.

Steel Chosen

Steel sheet was chosen because it can be rolled into sheets as thin as 0.001 in. and still be heat treated to develop its former high strength. It also has good welding and forming characteristics and is inexpensive.

With a yield strength of 200,000 psi, a 1.00-in. wide by 0.001-in. thick piece of steel can carry an axial load of 200 lb. A 1.00-in. strip of this steel as thick as ordinary newspaper—0.003 in.—can carry a 600 lb. load.

Since practical considerations ruled out use of individual stiffeners spaced closer than ⅜-in., miniature corrugations became the practical means of obtaining closely spaced stiffeners for stabilization.



WORKER adjusts the multiple-head welding unit. Spot welding is completed by rollers running in each corrugation.

Corrugation design is a compromise between theoretical and practical considerations. Symmetrical for structural assembly details, the 0.050-in. corrugation flat face is dictated by welding requirements.

Welded Corrugation

When welded to thin skin, miniature corrugations can provide a very rigid surface covering for the airplane. This combination is rigid in one direction only and very strong locally, as well as having good bending stiffness in one direction.

Structure assembly built up from the sheet did not present serious difficulties even though gages range from 0.001 to 1.00 in. Assemblies are easily built up from smaller sub-assemblies with the only limitation to size being welding accessibility.

Spot welding of corrugation to skin can be done with multiple welding units with a roller running in each corrugation. A certain amount of hand work is required for final assembly but can be simplified by careful design.

A variety of welding tips can be made for use in touch-up work or for welding hard-to-reach places. Good welds are consistent if clean, matched surfaces and correct machine settings are used.

Welding thin sheet to heavy bar was successful with only limitation being thin sheet must be less than 0.016-in. thick. Fusion welding of 0.002-in. foil was also satisfactorily completed.

Weight Saving

Using this design method, a large weight saving was easily made and in several cases was reduced 50%.

For example, panels formerly made with brazed honeycomb now have "Z" stiffeners made from 0.006-in. steel. The Z's are welded to 0.010-in. steel skins at spacings of 0.625 to 1.25 in. representing a weight savings of 18%.

Firewalls have been made from 0.002-in. type 321 steel sheet welded to corrugated steel, representing a savings of 60% over the 0.016-in. steel firewall originally planned.

A lightweight steel tailpipe 14-in. in diameter and 12 ft long has been fabricated using the same materials as for the firewall. The cylinder is stiffened by steel bands 0.030-in. thick and 0.375-in. wide, and are spaced 2 ft apart. Total weight is 14.7 lb and replaces a design weighing 35 lb.

This strength-to-weight design led logically to use of very thin sheet, which in turn led to miniature spot welded corrugations. But even with these savings, weight in aircraft design is still a continuing problem.

SANDWICH, composed of stainless plates inside and carbon plates outside, is first tack welded together.

Welded steel sandwiches offer a further solution

A FURTHER ANSWER to the aircraft industry prayer might be found in a research and development project being undertaken by United States Steel Corp.

In progress is a program designed to reduce weight penalties imposed by use of comparatively narrow steel sheets presently available. Its ultimate objective is production of thin stainless and alloy steel sheets rolled to widths never before achieved.

Initial success has been attained through a "sandwich" rolling process, which demonstrates the feasibility of producing steel sheets up to 90-in. wide—nearly twice the width of light-gage stainless and alloy sheets now being made by conventional methods.

Reduced Weight

These and even wider stainless and alloy sheets can reduce the overall aircraft and missile weight by eliminating many joints and seams now necessary in their fabrication. At the same time, the advantages of stainless and alloy steels—strength, toughness and resistance to heat and corrosion—can be retained.

The new method "sandwiches" stainless or alloy steel plates between two heavier plates of ordinary carbon steel. The assembly is closed with welded-in side and end bars, heated and then rolled.

A typical experimental "sandwich" contained four 12% chromium, 5/16-in. stainless plates. These were enclosed in 1-in. carbon steel cover plates so that the assembly, after welding, was about 3-in. thick.

Welding Process

Cover plates and side bars were first tack-welded together. With the assembly in horizontal position, all seams were completely closed with E6010 electrodes to keep out any flux or other foreign matter during final welding.

Secondary passes were completed with E6024 iron powder electrodes to further close the seams. Power supply for all manual welding was a 600-amp welding machine with electrodes drawing 350 to 400 amp.

PLATES inside the steel sandwich have been coated with a separating compound to avoid fusion during the rolling process.

Placed in a vertical position again, the assembly was then brought flush to its edge by automatic submerged-arc process. The final weld metal was deposited with a low-carbon welding wire (0.10% carbon and 0.55% manganese). Power was supplied by a 1,200 amp machine with electrodes drawing 900 to 1,000 amp.

The welding is designed mainly to hold the assembly together during handling, heating and the first pass through the plate mill. The sandwich was heated by conventional methods. On the first pass the heat, combined with the high pressure rolling, performs a "blacksmith weld" of side and end bars to the cover plates.

Pressure Rolled

This welding keeps the assembly intact as the rolling process is completed. Plates were treated first with separating compound to prevent fusion during rolling.

Rolled down to a plate ⅜-in. thick, 100-in. wide and 250-in. long, reduction amounted to a total of about 90%, effecting the same reduction in each plate in the assembly. The original 5/16-in. stainless plates were rolled to a thickness of .033-in. each.

When the expendable end and side bars were sheared off to open the assembly, the stainless sheets measured 90-in. wide and 230-in. long.

Revamping of the rolling mills to supply more power or stiffen the rolls was not necessary since the sandwich assembly had the working characteristics of the carbon steel cover plates and not the stainless or alloy sheets inside.

United States Steel is now working to refine the technique. Studies are being made to determine best design and assembly methods, as well as to develop suitable ways to heat treat, quench, flatten and finish the sheets to meet aircraft and missile requirements.

OPEN a hot rolled metal sandwich and the result is the widest thin-gage stainless and alloy steel sheets ever produced.

Welded yawl cops cups

By F. W. Foerste

ONE PHENOMENON noted by observers of recreation-conscious Americans is our increasing tendency to take to the water.

Throughout the country, more and more sportsmen are digging into their pockets to buy boats. These may be floated for fishing, for towing water-skiers, or simply for a day of placid cruising in the sun.

Contented though he may be with what he already owns, each would-be Magellan dreams of his perfect boat. This may be only a 12-ft motor launch. But always the dream is there.

Similar dreams came true for two Wisconsin yachtsmen recently when they took command of 58-ft, all-welded aluminum yawls . . . the largest ever built in this way.

Duty Becomes Pleasure

A yawl—in case there are any baffled landlubbers among us—is a fore-and-aft rigged vessel carrying a mainsail and one or more jibs, with a mizzenmast far aft.

In days when clipper ships skimmed the oceans, yawls served as a ship's small boat, suitable for short trips ashore and for emergencies at sea. In these days of diesel and nuclear power, however, yawls are pleasure boats, commonly adapted for long distance cruising or for racing.

It was for this latter purpose—ocean-racing—that Clayton Ewing of Green Bay, Wis., ordered construction of his welded yawl. On the other hand, George Kress, also of Green Bay, preferred to cruise aboard *his* boat, the *Aria*.

Designed by Sparkman & Stephens, Inc., of New York, and built in the Manitowoc, Wis., yards of Burger Boat Co., the yawls are said to reach top-limit speeds of eight knots per hour. (Note for landlubbers: this is roughly equal to a little over 9 land miles per hour; a Navy cruiser has an estimated peak speed of 33 knots per hour.)

Ewing's boat, *Dyna*, was first to slip down the ways, with the *Aria* following shortly thereafter.

No news to weldors . . .

She is the first all-welded aluminum yacht. Her predecessors are riveted boats, with all the drawbacks of riveted construction, high cost (riveting is twice as expensive as welding), leakage from popped or strained rivets, and hull marred by rivet heads.

—Sports Illustrated

Vital Statistics

Both *Dyna* and *Aria* are 57-ft 5-in. in overall length. At their widest point—the beam—the sister ships measure 13-ft 6-in. and weigh 48,000 lbs . . . including an 18,000 lb ballast keel of cast iron and lead.

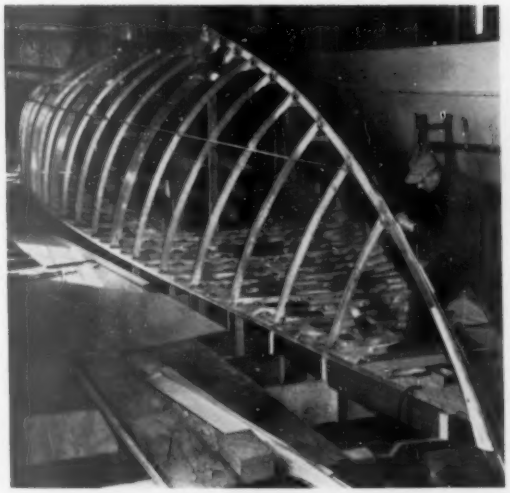
It has been estimated, however, that *Dyna's* hull is 9,700 lb lighter than it would be had it been constructed of steel. The welded aluminum hull also has an 8,200 lb weight advantage over a similar hull formed of wood, traditional boat material—and strength to spare.

Even so, the yawl weighs more than it must because this was relatively new work to Burger and so heavier aluminum hull plates were used for positive strength.

The secret of comparatively light weight, high speed and strength actually is no secret: it lies in the all-welded aluminum construction, which allows the boats to be lighter and stronger than similar craft fabricated with rivets.

Because *Dyna* was Burger's first non-experimental, all-welded aluminum boat, weldors were handed an opportunity to explore new welding territory.

For example, in first attempting



ALUMINUM framing, ribs and flat bars in place and almost entirely welded. Metal was easy to prepare because it shears, saws, and shapes as simply as wood. Note that ribs are welded to every other flat bar, giving light weight, but not affecting strength characteristics. Tanks in center hold water. Fuel tank is integral with boat, set in hull.

HULL plates of ¼-in.-thick aluminum in early stage of fabrication. Fillet welds join plates to flat bars and plates are welded together with butt welds. Burger frequently welds 3/16-in.-steel shell in boat building. Dyna is largest aluminum boat ever welded by Burger. "Are we proud of Dyna?" asks president H. C. Burger. "It's absolutely going to revolutionize the yacht industry." Ability of welds and material to resist corrosion was a persuasive factor for fabricating boats in this way.

to Mig (metal inert-gas) weld Alcoa 5154 aluminum, 2½ by ⅜-in. aluminum flat bars to hull sections with 3/64-in. wire and an air-cooled gun, weldors found they were not getting maximum results. This was despite the fact that the metal was especially developed for marine fabrication and for welding.

Change for the Better

As soon as weldors switched wire to 1/16 in., and changed to a water-cooled gun, the situation immediately improved.

A great deal was learned about weld preparation as well. Aluminum oxidation, although it holds off corrosion, is a barrier against sound welds. For this reason it was imperative to clean the metal with solvents and by mechanical means.

Solvent was also used to remove grease and dirt accumulated on the aluminum during rolling (which, with bumping and stretching, was employed to shape the plates) and storage.

Mechanical cleaning was done with a special wire brush attached to a pneumatic-powered grinder.

Mig was used throughout welding. First to be welded was the skeleton framing, made of the flat-bar stock. As on all metal boats, fabrication proceeded upside down: beginning with the deck (100 transverse supports) and ending with the keel (longitudinal support).

Ribs Welded

To 50 of these transverse bars were welded aluminum ribs of identical dimensions. In this way, the boats would have strength, yet sidestep a great number of longitudinal members which both add weight and bulk

NEARLY completed, hull will next be sand-blasted, given a priming coat of vinyl. Further finishing is done with five or six coats of special vinyl developed especially for welded aluminum.

HAVING been welded, Dyna is hoisted upright preparatory to superstructure work. Note clean welds.

PLUSH interior of forward cabin is finished in blond oak. Other bunk not visible.

large in living quarters and storage spaces.

Sixty ¼-in.-thick aluminum plates were then Mig welded to the ribs to form the hull. Being aluminum, even the largest plates weighed only 200 lbs—and could easily be swung into place by a chain hoist.

Plates were fillet welded to ribs with beads intermittently spaced 3 in. on 12 in. centers. Fillets ranged from 5/16 in. to ⅜ in. in size. Plates were joined to one another by butt welding.

Power for this was supplied by a standard 300-amp d-c welder. Although amperage spread from 175 to 225, dictated by weld position and thickness, average setting was 200 amp.

Approximately 30 cu. ft. of 100% argon was consumed each hour during welding.

GALE NELSON, head Burger welder, at work on spar.

Weldors found it of great help to have welds chipped and flushed shortly after welding. Thus, with a backward glance, they were able to check weld porosity. If weld deficiencies were located, it was then easy to make any necessary welder or gas adjustments.

Pros . . . Cons

Burger found that the cost of welding aluminum was somewhat higher than welding steel. But this would be offset by lower maintenance costs once the boat was put into water, because of the leakproof, almost corrosionproof hull. And, of course, expenses were much lower than had the aluminum been riveted.

Because the ¼-in.-aluminum plates were less rigid than the 3/16-in. steel regularly used at Burger's, they were somewhat more difficult to weld. However, this too was balanced by a welded-aluminum advantage: less distortion was encountered when welding aluminum than when welding steel.

All in all, Burger states, welding problems were fewer on aluminum than on steel.

Fabricated in this way, the yawls offered other bonuses. For instance, it made possible installing a watertight bulkhead near the bow of the boats. Should a head-on collision occur, this bulkhead will trap water that otherwise would flood the rest of the boat.

Another bonus is that the metal can form one side of storage tanks for water and fuel. Taking advantage of this fact, and also the relative lack of longitudinal members, designers Sparkman and Stephens incorporated an aluminum fuel tank in the keel, and water tanks in the center of the boat. Thus, *Dyna* has twice the fuel storage space and 25% more water storage than the usual yacht her size.

Extra space below decks permits roomy, comfortable quarters. A four-bunk main cabin, a two-bunk forward cabin, a one-bunk crew's quarters, a galley, and navigator's space complete the shipshape arrangement.

Following welding, the hull was sand-blasted, treated with etching acid, and given a priming coat of vinyl. Because aluminum is subject to *some* corrosion, especially in sea water, the entire yawl was finished with five or six coatings of a special vinyl, specifically developed for protecting welded aluminum.

Deck Construction

In addition to its keel, *Dyna* has a 1-in.-aluminum single-thickness centerboard to stabilize her while in deep water and which retracts in shallow waters.

Transverse deck-supports are covered by fiberglas over plywood. Topping this deck is a 76-ft mast, also of aluminum, as are the remaining masts and spars, excepting the spruce mizzen boom.

When fully rigged, this assembly of horizontals and verticals can fly 1,604 sq ft of sail.

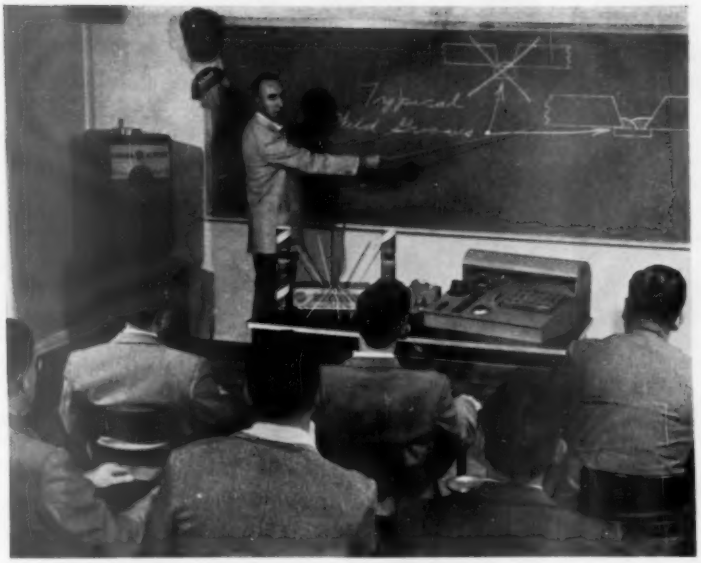
Welded-aluminum components:

frame
flat bar longitudinal supports
ribs
hull plates
centerboard
keel plate
rudder
forward watertight bulkhead
aft bulkhead
mainmast
main boom
mizzenmasts
spinnaker poles
water tanks
fuel tank

Should Neptune sulk, however, and winds not fill the canvas, the skippers have only to flick on their auxiliary, 89-hp, Diesel engines.

Are welded aluminum sailboats fast? All returns are not yet in, but *Dyna* scudded into port ahead of 74 other racing boats entered in the Port Huron-Mackinac race held on Lake Michigan last summer. Not inclined to be content with her first place and overall win, *Dyna* went on to cop Class A in the Chicago-Mackinac race.

What is the future of welded aluminum yachts? H. C. Burger, president of the boat building firm, stated authoritatively, "If a man wants speed and a light yacht, someday soon he will turn as naturally to aluminum in yachts as he does to aluminum and fiberglas in smaller boats today."



CLASSROOM instruction is conducted at the welding institute by a top man in the field. Introductory course gives basic welding terminology.

Solution to A. O. Smith's problem is a welding school

HOW IS THE BEST welding performance obtained in a company with nine manufacturing plants, each producing products requiring varied welding techniques and processes?

A. O. Smith Corp., Milwaukee, found a solution—organize a welding school and capitalize on a training program designed to produce such performance.

The company's welding institute is now completing four years of operation. In that time comprehensive welding courses have been given to a student body including customers, non-customers, vocational instructors, neophyte weldors, and personnel from each of A. O. Smith's plants.

An expanded program is now being planned to attract even more non-company people.

When the idea was initiated, it was realized that supervisors, inspectors and operators lacked consistency in judgment of welding quality, practices and applications. More than a mere welding school to train operators was required.

No Mere School

All levels of the productive team had to be trained to accomplish three important objectives: disseminate uniform standards of welding theory and application, improve quality to reduce welding costs, and help the company maintain its position in the welding industry.

In establishing the institute, J. J. Chyle, director of welding research, was asked to determine the pattern of welding problems.

The research laboratory is staffed with specialists in every phase of welding and has technicians with years of laboratory and shop experience. These men solve a broad range of problems submitted from all over the world.

INSTRUCTOR points out weld characteristics to a typical student. Right, the student gains practical knowledge in semi-automatic submerged-arc welding.

Coordinated efforts resulted in formulation of the most common questions and problems presented. With this information, the laboratory and the corporation's education and training department worked together to organize the school.

While the research group looked after technical aspects of the activity, the education and training department provided instructors and overall administration.

Both basic and advanced courses are offered, each running for a two-week period, or as a special situation requires.

The basic course, designed as an introduction to welding, provides a solid speaking familiarity with welding terminology, processes and application, plus practical experience.

Class Instruction

Instruction is divided into 30 hours of lectures, 30 hours of practical application and 20 hours of counseling on individual welding problems. Full use is made of workshop facilities, including all known practical welding processes and equipment.

Students themselves formulate and solve problems under the guidance of the workshop's instructor. The corporation's plants utilize almost every type of welding process, so a student can observe any process in actual shop operation. He can also gain first-hand information by discussing problems with top men in the welding field.

Lecture material is continually revised to reflect new developments in the field, and is supplemented by movies, slides, charts and other modern training aids.

Since each lecture presentation is made by the author, students can obtain authoritative answers to their questions. Class size is limited so the instructor can give maximum attention to each student.

Varied Attendance

A. O. Smith's supervisory group was first to receive instruction to assure more uniform instruction of operators at the departmental level during the program's initial stages. Since then, engineers, designers, researchers and quality control men have attended.

Attendance of the latter group was necessary in order to coordinate on a corporate-wide basis the efforts of all persons concerned with quality maintenance and cost reduction. All personnel can thus proceed from a uniform basis as applied to welding.

Salesmen are also periodically brought in to keep them up-to-date on the latest developments in welding theory and application.

ANOTHER instructor regulates an automatic submerged-arc welder while the student closely follows the process.

Successful Program

Requests to participate in the program came from customers and others in the industry after the courses proved successful. The requests have been readily granted. In 1956 alone, more than 24,000 hours of uniform standards of welding and its application were taught—6,250 hours more than in 1955.

Almost 100 men sent by 45 customer and non-customer companies have been graduated from advanced courses, including students from France, India, Burma and South America.

After sending four men to the institute, a large shipbuilding company is now considering a similar course of study to train its own men. Other companies have asked aid in setting up company schools modeled after the institute.

The school's effectiveness has been proved to the satisfaction of managers of A. O. Smith divisions and by other firms as well. In a recent emergency, the institute was able to provide 300 trained weldors for frame welding during a two-month period.

STILL another phase in the student's education is acquainting himself with the Mig welding process. Right, the instructor sets up a spot welding problem for the student during another phase of instruction.

Whys and Hows of stress relieving

INDUCTION heating unit for stress relieving.

By Gerald Scott
Design Engineer
Hobart Brothers Co.

EVERY TIME you make a weld, the structure of metal you are working on is slightly changed. Often, this change will set up harmful stresses in the metal—and some specifications call for a relief of these stresses.

This, as a result, requires a stress-relief program.

The introduction of new alloys, and use of high temperatures and pressures in welding fabrication make apparent the need for *scientific* stress relieving.

It is for this purpose that a resumé of a stress relief program, its practices and procedures, is included here.

Definitions

Stress relief: this term is applied to any means which reduce residual stresses. Such methods may be thermal or mechanical, or a combination of the two. We will be concerned with thermal means. Specifically, stress relief is *uniform* heating of a structure below the critical range of the base metal, followed by *uniform* cooling.

Critical range (transformation range): the temperature interval within which austenite forms while ferrous alloys are being heated. Also, the temperature interval within which austenite disappears while ferrous alloys are being cooled. The ranges are distinct, sometimes overlapping, but never coinciding.

Temperature gradient: difference in temperature between two points a unit distance apart. (*Example:* in arc welding two steel plates, when temperature 1 in. from weld is 200 F, and weld temperature is 2,800 F, the temperature gradient is 2,600 F/in. Temperature gradient, however, is not constant at any moment during the welding procedure.)

Thermal stress: a stress set up within the structure, caused by rapid and uneven expansion of material in the heat-affected zone due to high arc temperature and high temperature gradient.

Soaking: stress relief temperature is maintained for a minimum of one hour, regardless of material thickness, but usually is based on the rate of one hour for each inch of material thickness.

Preheating: heating material to an elevated temperature before welding. This reduces the weld's cooling rate by lowering temperature gradient. (Not to be considered a substitute for stress-relief.)

Skin effect: in induction heating, refers to depth of penetration of the induced field, which generates heat.

Quenching: rapid cooling from an elevated temperature by contact with liquids, gases, or solids.

Demagnetizing (before welding and after preheating): because of arc blow, welding magnetized material is practically impossible. With an m-g power source with proportional control, demagnetization is possible by gradually reducing induction coil current to zero before cutting off its power.

Proportional control: control system varying input to induction coil according to heat demand at any particular instant. This ranges from zero to maximum generator output and produces evenly controlled heating, soaking, and cooling cycles in a stress relief program.

Soaking: prolonged heating of a metal at a selected temperature.

Purpose of Stress Relief

Stress relief of a welded joint has four very practical advantages: it reduces thermal stresses, removes hard zones, promotes metal relaxation, and lowers the metal's Brinell hardness.

Thermal stresses occur at a localized point where pressures caused by high arc temperatures expand and compress metal next to the cold zone. Non-uniform heat distribution is a cause of this. Reducing temperature gradient is one way to combat thermal stresses.

Hard zones result when nitrogen or oxygen is absorbed from the air, and carbon content in deposited metal increases. These can be removed by evenly heating the metal to a point sufficient to cause finely divided carbon particles to enter solution and precipitate on larger particles. This creates larger and fewer spheroidal carbide particles, which tend to be soft and ductile.

Relaxation

Hard zones are also caused by the quenching action of welding on cold metal, and by uncontrolled cooling during the stress relieving cycle and after welding. Controlled cooling during stress relieving will alleviate this condition.

Stress relief promotes metal relaxation—*i.e.*, relaxation of stress due to creep—by reducing the metal's yield strength below imposed strength. At temperatures above 1,000 F, relaxation takes place and shrinkage stresses are relieved.

Reducing the Brinell hardness of a material is a function of the controlled-cooling cycle of stress relieving. A Brinell hardness below some specified figure is often included in job specifications to insure that both stress relieving and a correct controlled-cooling program have been carried out. It is not, however, an infallible test.

Carbon Steel

Generally, stress relieving should be used on carbon steels with a minimum tensile requirement of 40,000-75,000 psi when they have a thickness of ¾ in. or greater. Other metals which should be stress relieved include carbon-molybdenum, and steels with thicknesses of ½ in. or greater. Chrome-molybdenum, chrome-vanadium, nickel, and nickel-chrome steels should also be stress relieved, regardless of thickness.

However, any welded metal can be stress relieved, and should be if specifications require it. (High-alloy martensitic, ferritic and austenitic steels should be stress relieved upon agreement between purchaser and fabricator.)

In addition, welds between dissimilar ferritic metals must be stress relieved if either metal requires the treatment.

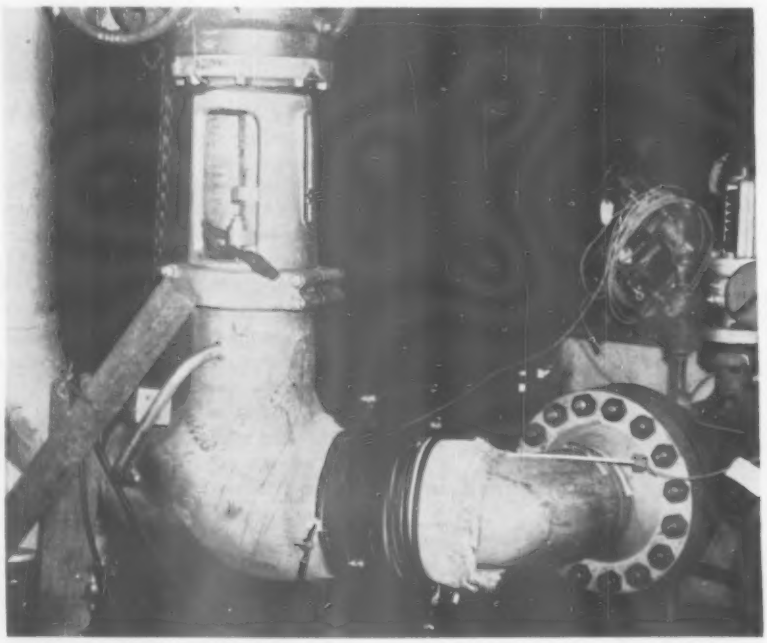
A Stress Relief Program

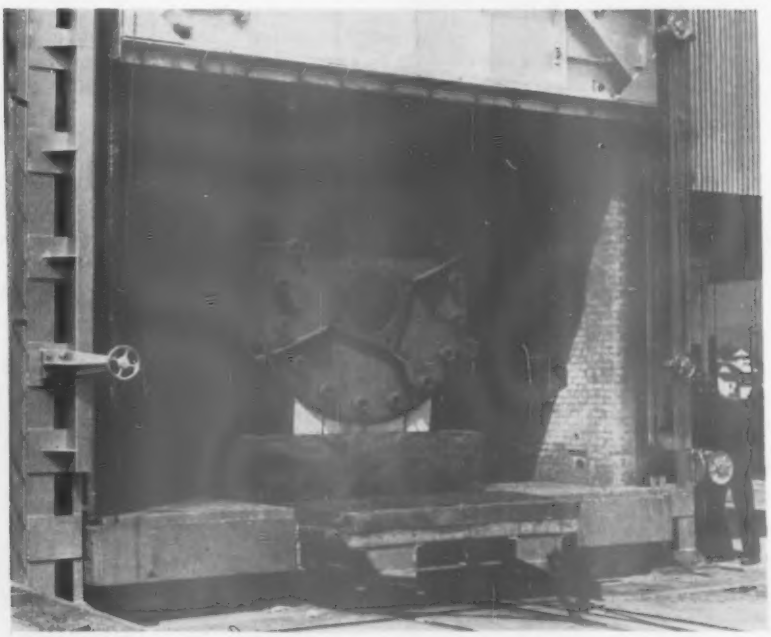
Although the particulars of any stress relief program should be specified by the designing engineer, the fabricator or the purchaser, phases and effects of such a program will generally follow conditions listed here.

Heating should be slow and controlled. This provides a low-temperature gradient by allowing a heat "runout" in the metal. It also will prevent thermal stresses from building.

Failure to control heating rate is, unfortunately, one of the most common errors in stress relieving. Such errors lead to thermal stresses like those caused by arc temperatures, except that they are found farther from the weld joint.

Heating rate can be best controlled





ABOVE: Stress relieving programs are vital when stresses have been formed during welding; their purposes: reduce thermal stresses, remove hard zones, promote metal relaxation, and reduce metal's Brinell hardness. Author states induction heating is the "most refined method of stress relieving." Heat is generated directly within the metal and can be adjusted with a proportional control motor-generator power source.

LEFT: steel tank being rolled on flat car into stress relieving furnace. Fire brick provides sufficient insulation to prevent chills and heat losses, which could ruin a stress relieving program.

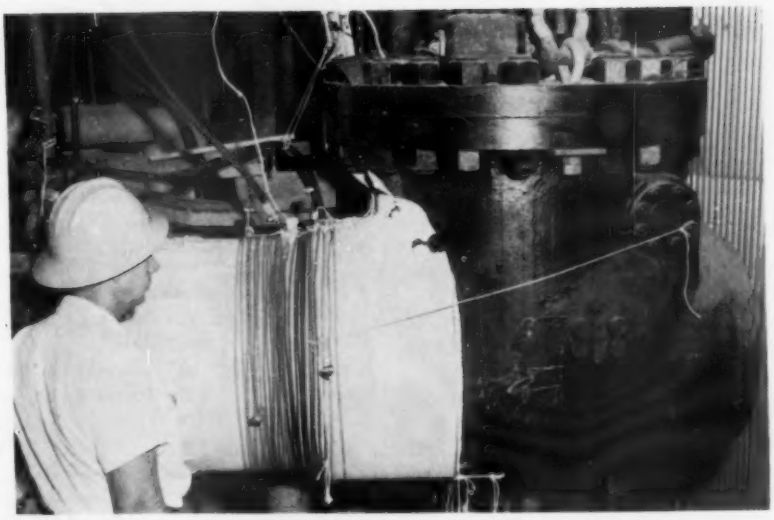
if the fabricator concentrates on material size, thickness, and the metal itself, instead of attempting to tailor his program to a current work day.

Soak—or stress relieving—temperature will be approximately 100 F below the critical (transformation) range of metal being handled. This is the temperature inverval within which austenite forms while ferrous alloys are being heated. The range depends upon alloy composition and temperature-change rate, especially during cooling.

Soak time depends upon metal thickness. Generally, however, it is reckoned at one hour per inch of thickness. But metal must be soaked for one hour, regardless of thickness.

A correct soak time distributes heat evenly throughout the metal. It also insures complete metal relaxation to relieve residual stresses.

A controlled cooling rate—which prevents hard spots from forming—diminishes quenching action. With a controlled rate, a low Brinell hardness is gained and fresh stresses are forestalled.



PIPE with 24 in. diameter and ⅜ in. wall, located 100 ft from induction heating generator, being stress relieved.

Stress Relieving Methods

Large and/or complicated weldments are usually stress relieved in gas furnaces. With very large structures, however, the weldment itself frequently substitutes as a furnace. Sufficient insulation must surround the unit to protect against chills, or quenching actions on the outer surface, and to halt heat losses.

An early method of stress relieving was done with an oxyacetylene flame. Heating rate and heat distribution were controlled manually, and temperature was checked by heat-indicating crayons or color charts. Such methods, however, were often inaccurate.

A refinement has been made on this type of heating source. A gas ring is placed around the unit to be heated, and more even heat distribution is possible. A drawback of this method is that controlled heating and cooling is difficult to achieve.

A fourth heating system is by the resistance method. Here, wire is wrapped around the metal and connected to a power source. Insulation blankets the top of the wire to reduce heat loss by radiation. Heat is carried by convection.

This system can be controlled fairly well; however, there is a tendency for hotspots to form directly under the wire, with consequent danger of thermal stresses developing.

The most refined method of stress relieving is probably induction heating. Heat is generated directly in the metal itself and radiating heat losses can be controlled better than with other systems.

In induction heating, hysteresis in the metal and eddy current losses provide the heat in magnetic metals. In non-magnetic metals, only eddy current losses provide heat.

Induction Heating Frequencies

Although 60-cycle current has generally been used with transformers for stress relieving purposes, it is possible to use even higher frequencies.

Since a slow and uniform heating rate is a factor of the frequency employed, the 400-cycle system, using a motor-generator for power, can give more accurate heat control than the 60-cycle transformer system Also a smaller wire size can be used to construct an induction coil since currents used are much less than those with the 60-cycle system.

Even though skin effect is a greatly exaggerated problem, the furnace, resistance, and gas flame methods actually complicate it more than induction heating. The reason for this is that the former methods generate heat from the outside of the metal toward the inside, while induction heating causes heat to come from within the metal itself.

POSTHEATING with an oxyacetylene torch. This method is often demanded when no other heating units are available.

Control over the power source is equally important for slow, uniform heating. Automatic controls are usually preferred over manual types for this work.

Transformer Supply

It is true that automatic controls are found on almost all stress relieving systems. The most accurate of all systems, however, is the motor-generator power source with proportional controls as fitted for induction heating.

With a transformer used as a power source, the control system is an "on-off" type. In this arrangement, the transformer puts full power into the coil during the "on" cycle. This causes a heat rate so rapid that thermal stresses could develop if heating rate was faster than heat-transfer rate through the metal by conductance.

Motor-generator units, on the other hand, being equipped with proportional controls, can be adjusted from zero to maximum generator output.

In this way, it replaces "on-off" cycles—and their fluctuating input—with an input that is continuous and varies with heat input at any given instant. Variations can be obtained at any moment during the heating cycle, soak time, or cooling cycle. Thus. a uniform heat is present at all times.

Another instance when proportional controls are valuable is when conditions surrounding the metal suddenly change. An example of this would be a sudden draft sweeping over the unit. In such a case, the controls automatically adjust to the induction coil to compensate for heat loss, and then hold the desired uniform condition.

Preheating for Welding

Preheating for welding is vital to reduce shrinkage stresses, thermal stresses and localized hardness. Nevertheless, it must be remembered that while preheating is an important addition to stress relieving, it is *not* a substitute for it.

The technique is frequently used—and recommended—on carbon steels with a minimum tensile strength of 70,000 psi or higher. Preheating is also practiced on carbon-molybdenum, chrome-molybdenum, chrome-vanadium and nickel steel. Temperatures for the method range up to 500 F.

Once at preheat temperatures, metals should soak for a short time. A soak period permits heat "runout" which reduces thermal stress by lowering temperature gradient.

This question frequently arises, "When should preheating be done?" You can answer it if you know the analysis of metal to be welded. Simple arithmetic, using carbon as a constant, will provide a key to preheating questions. The following table will illustrate this.

Element	Constant
Carbon	1
Phosphorus	2
Chromium	5
Vanadium	5
Manganese	6
Molybdenum	4
Nickel	15
Copper (above 5%)	13
Cobalt	150

Silicon and sulphur in steel have no effect on this table and have, therefore, been omitted.

Example: Let us now assume we have a steel with the following analysis:

C—0.22	Mo—0.20
P—0.02	Ni—3.0
Cr—0.50	Si—0.11
V—0.10	S—0.03
Mn—0.45	

Now divide these figures by their constant number:

C 0.22/1=0.22	Mn 0.45/6=0.075
P 0.02/2=0.01	Mo 0.20/4=0.05
Cr 0.50/5=0.10	Ni 3.0/15=0.20
V 0.10/5=0.02	TOTAL 0.67%

Since preheating should be done when percentages go over 0.32%, our steel must receive the treatment.

Postheating

Terms for postheating—annealing, hardening, tempering, etc.—have been used very loosely and are often lumped together under the category of stress relieving. They are different, however, because while stress relieving uses temperatures *below* the metal's critical range, all postheating methods use temperatures *above* the critical range.

Annealing, for example, is a technique in which the metal is heated 50 to 100 F above the critical range. Its cooling range is controlled because this postheating method is used to soften steels.

In hardening, the metal is again heated 50 to 100 F above the material's critical range, but cooling rate now exceeds the critical cooling of steel.

Hardening and tempering is a method which involves heating metal and quenching it to form a martensitic structure. Following this, the metal is tempered, or drawn, by reheating to a temperature necessary for the desired amount of ductility, tensile strength, yield strength and hardness.

Austempering is generally applied to thin sections. This type of postheat requires that material be heated to 50-100 F above the critical range. It is then quenched to a lower temperature and, finally, quenched in a salt bath.

Martempering requires metal to be heated 50-100 F above the critical range and quenched to a lower temperature, like austempering. This heat is held for a time, then the metal is cooled slowly.

Normalizing involves heating the material to approximately 100 F above the critical range and allowing it to cool in still air.

THAT careless guy gives me a pain in the neck

New all-welded diesel manifold holds promise of

Maintenance saving for the railroads

WELDOR joins a bellows to the stainless manifold.

A PROMISE of longer diesel-manifold service life, reduced freight costs, and maintenance savings of millions of dollars may soon be fulfilled in a big way for the nation's railroads.

The relatively new manifold, an all-welded stainless steel construction by Hanlon & Wilson Co., Pittsburgh, has been given extensive on-the-road tests by more than 10 major railroads during the past two and a half years. It was developed as a replacement for the Alco "244" diesel locomotive.

Experienced Firm

H & W has manufactured stainless mufflers, heaters and exhaust manifolds for aircraft since 1940. In 1954, it decided to apply similar design techniques to a manifold model that would meet stringent railroad service requirements. (The design can also be adapted to marine diesel and stationary engines.)

Welding process selected for the job was Tig (tungsten inert-gas)—one with which H & W was already well acquainted. Electrodes were supplied by Alloy Rods Co. of York, Pa.

Standard design for manifolds used in most of the 25,000-plus diesel locomotives operating today is a cast steel unit. Slip joints in the tubing help contain the engine's hot exhaust gases, which reach temperatures of 1,300 F. Such joints, however, have rung up a costly record as principle targets during engine overhauls.

Major engine overhauling cycle with standard manifolds is 22 months, but the new easier-to-install manifold can outlast this period.

The slip joint is likely to fail in one of two ways: *(1)* corrosive effects of exhausted gas will cause it to "freeze", or *(2)* the joint will crack from expansion, permitting gases to escape and wreak havoc on electrical circuits when wiring insulation has corroded.

Stainless Used

Weighing less than 500 lb—approximately one-half the weight of a standard manifold—the new model features a series of 14 bellows, each of which encircles a sleeve. As these sleeves open and close to accommodate changes in gas temperatures and pressure, the bellows surrounding them also expand and contract—effectively preventing possible gas leakage, as well as reducing vibration problems to a minimum.

BELLOWS is inspected prior to being welded to stainless tubing of manifold.

Except for the 12 cylinder flanges and the supercharger casting, the manifold and insulating shroud are made of type 321 stainless. Cylinder flanges are mild steel and the supercharger casting is made of type 347 stainless.

All manifold tubing has a 0.062-in. wall thickness, and must meet OD specifications of 3.750 in. At all cylinder flanges, and at the supercharger casting, tubing is reinforced with 0.050-in.-thick type 321 stainless sleeves.

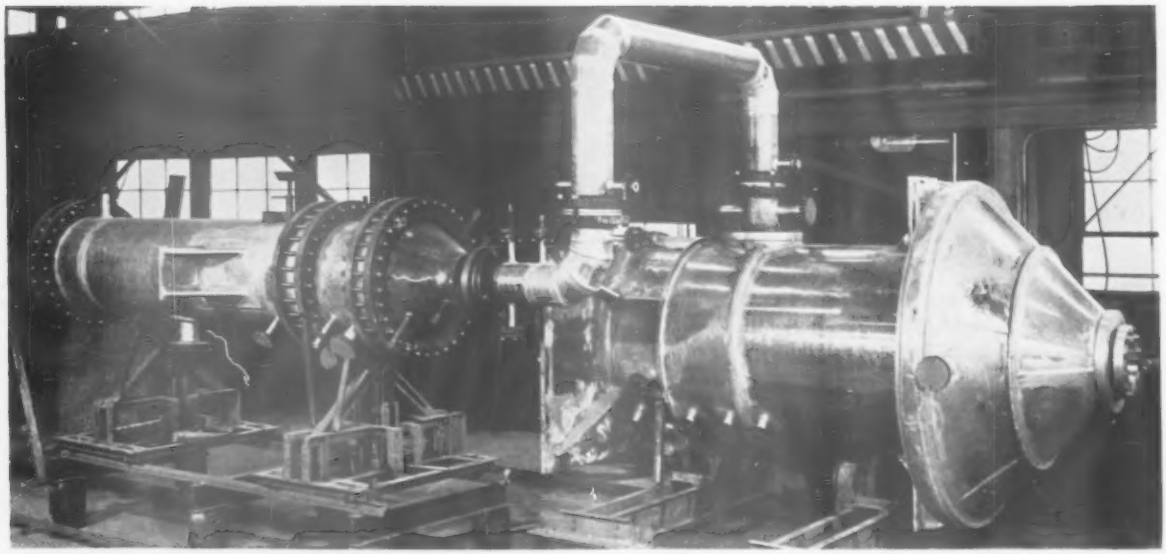
As described by Philip Hoener, H & W plant superintendent, here is the way the manifolds are fabricated:

"The various tubes are formed in longitudinal halves on a 500-ton hydraulic press using Kirksite dies. Tube halves are pre-formed, either on special dies or by using rubber to control the flow of material.

"Final forming is done in a finishing die, and the halves are then nibbled and passivated in preparation for welding.

"Using the Tig process and an argon back-up, tubing half-sections are welded together. The 14 bellows assemblies are then Tig welded to tube sections using filler wire. The four main sub-assemblies are pressure-tested to twice the working pressure.

"Chromium-nickel E347-15 and -16 electrodes were used for all other manual welding in three diameters: 5/64-in. between tubing and cylinder flanges; 1/8-in. between flanges and reinforcing sleeves, as well as between reinforcing sleeves and the supercharger casting; and 1/16-in. between the reinforcing sleeves and the tubing."



A "common" job cost this firm too many $$$

By R. H. Hoefler
Chief Welding Engineer
Kaighin & Hughes, Inc.
Toledo, Ohio

ACCEPTING A JOB that had none of the earmarks of a true problem type, Kaighin & Hughes actually turned over to its Fabrication Div. in Toledo, and to K & H Engineering (also a division), a welding task that demanded exceptional attention.

A leading chemical firm contracted for the fabrication of two fully-jacketed reactor vessels and two tube-type heat exchangers . . . all of which were to be placed in high-pressure service at temperatures to 600 F. Selected as base material was aluminum alloy 5052-0.

First problem encountered was one of space. The fabrication shop is designed primarily to handle code welding of all alloys of pipe, so a large undisturbed area had to be prepared so that the vessels could be easily manipulated for all-position welding.

And while this rearrangement was going on, planners had to keep in mind the fact that all welding would be done by the Tig (tungsten inert-gas) and Mig (metal inert-gas) processes.

Little-Known Facts

In early stages of production planning, it was learned that little was known of the alloy's weldability and weld properties. The smattering of information provided by the supplier proved false.

To fill-in broad gaps in data concerning the alloy, K & H's welding department undertook an extensive and costly development program. Their efforts resulted in the establishment of an adequate welding procedure.

All weldors chosen to work on the vessels then had to be qualified in all positions under these procedures (in

the manner outlined in Section 9 of the ASME code). Considerable cost was involved in this qualification because of training required on the new alloy. Only through close coordination between shop and laboratory were these costs kept at a minimum.

As production got underway, it was obvious that this coordination was a "must", and that normal shop routine would not suffice for this job. Good housekeeping for normal aluminum fabrication, for example, was poor housekeeping during this welding job. All weld areas had to be kept spotless and carefully protected until welding was completed.

Meetings and Methods

Frequent coordination meetings between Engineering, Welding and Production were held, and the results of these meetings were discussed with weldors at a second meeting. Procedural changes could be made only after approval of these departments.

On all phases of this work, Tig welding was done with water-cooled torches using a-c current and high-frequency arc starting. Pure argon was the shielding gas, and the tungsten electrode was a 2% thoriated type.

5052-0 welded with 5154	Yield	Ultimate	Elongation
As welded	13,265	28,110	28.0%
Postheat 650 F/24 hr	13,780	28,170	28.0%
Postheat 700 F/24 hr	13,420	28,120	28.0%
Postheat 750 F/48 hr	13,440	28,210	29.0%
5052-0 welded with 5356			
As welded	15,050	27,960	28.0%
Postheat 650 F/24 hr	14,330	28,470	27.5%
Postheat 700 F/24 hr	15,040	28,090	28.0%
Postheat 750 F/48 hr	15,270	31,410	29.0%

Note: All specimens broke in base metal.

Mig welding was done with a constant-potential current source and a mixture of 75% helium, 25% argon gas. Gas flows were 25 cfh for Tig welding, and 35 to 40 cfh for Mig. A preheat of 350 to 400 F was maintained during all welding with the aid of insulated resistance coils.

Alloys 4043, 5154 and 5356 were investigated as filler materials. It was found that 4043 was the easiest to handle, but developed a brittle weld with an ultimate strength lower than that of the base metal.

Alloys 5154 and 5356 gave satisfactory welds with proper control, and 5154 was selected as the filler wire for the job because of its lower magnesium content (as deposited). Since the vessels were to operate at elevated temperatures, magnesium content was a definite factor because of the possibility of stress-corrosion cracking in service.

Temperature Variation

The jacket vessel (Fig. 1) consisted of a 4-in.-thick base plate from which pumps were to be hung, and three separate jacket zones, each separated by a circumferential baffle. During operation these zones may vary in temperature as much as 200 F, and stress problems involved are obvious.

	PROPERTIES		
4043 all-weld-metal sample	Yield	Ultimate	Elongation
As welded	9,160	20,940	5.0%
Heat treated 650 F/12 hours	7,850	17,610	21.5%
Heat Treated 850 F/12 hours	8,150	18,050	18.0%
5052-0 welded with 4043			
As welded	12,194	22,140	4.0%
650 F/8-hr postheat	7,750	17,130	14.0%
650 F/12-hr postheat	9,950	18,050	9.5%
650 F/24-hr postheat	10,540	20,140	6.0%
750 F/8-hr postheat	7,910	17,240	12.0%
750 F/12-hr postheat	10,140	18,250	8.50%
750 F/24-hr postheat	10,350	19,750	5.50%
850 F/8-hr postheat	10,730	21,610	9.0%
850 F/24-hr postheat	10,150	20,020	3.0%

The vessel proper was joined to a jacketed cone assembly by seal-welding the 2-in.-thick flanges of each section. Support plates for the platform mounting were welded to the outer shell below these flanges.

The heat exchanger actually consisted of one long and one short exchanger flanged together, with a jacketed cone assembly joined to both ends. Each exchanger consisted of 475 tubes—¾-in. OD and 0.095-in. wall thickness—welded into a 4-in.-thick tube sheet on either end.

Shells were formed from ½-in. aluminum plate, containing one longitudinal and one circumferential weld, which were joined to tube sheets with full-penetration fillet welds. The different sections were properly faced after welding, gasketed, and held in position with heavy steel flanges and alloy bolts.

Alignment Care

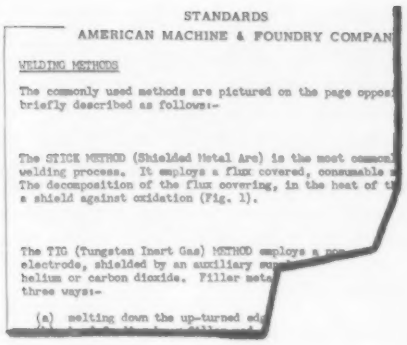
The heat exchanger and reactor vessel in each assembly were then joined with aluminum-jacketed piping. The top photo on p. 52 indicates the care required to mitre one elbow inside the other and maintain proper final alignment.

Upon completion, the vessels were first hydrostatically tested, then checked by filling them with ammonia gas and spraying sulphur dioxide on the exteriors. Test pressures were calculated to duplicate 1½ times the stress applied at 600 F. All vessels successfully passed these tests and are now in operation at the customer's plants, where they have successfully produced the proposed results.

Solving problems of design and fabrication is not a new experience for Kaighin & Hughes, Inc. The firm decided years ago that welding was a joining process not to be taken lightly. Active Welding Engineering and Quality Control departments have been maintained as an integral part of the organization ever since to keep abreast of latest welding techniques and their application.

All-Weld Specimen	*Silicon*	*Magnesium*	*Iron*	*Chromium*
5154	Trace	2.69%	0.15%	0.20%
5356	Trace	4.25%	0.18%	0.08%

Lacking a unified code of standards, the welding industry's next best step is self-regulation. Here is one firm's



STANDARDS
AMERICAN MACHINE & FOUNDRY COMPAN

WELDING METHODS

The commonly used methods are pictured on the page oppos
briefly described as follows:-

The STICK METHOD (Shielded Metal Arc) is the most common
welding process. It employs a flux covered, consumable
The decomposition of the flux covering, in the heat of t
a shield against oxidation (Fig. 1).

The TIG (Tungsten Inert Gas) METHOD employs a non
electrode, shielded by an auxiliary sup
helium or carbon dioxide. Filler meta
three ways:-

(a) melting down the up-turned edg

Self-imposed welding standards

THE WELDING INDUSTRY today is subject to numerous codes and standards regulating both quality and qualifications of welding and weldors.

More than 19 separate organizations provide regulations for welding, exclusive of various state and local regulations. WELDING ENGINEER has editorialized for years against this over-regulation—and still feels that unification of standards is a prime necessity for continued welding growth.

But until a set of standards under one coordinated organization is formulated, WE feels that self-regulation is the next best means of maintaining maximum welding safety, economy and quality.

A study of important aspects of one firm's code—a particularly thorough one—may help your firm in achieving its own practical rules for helpful welding standardization.

Self Regulation

Standards formulated by American Machine & Foundry Co., New York, begin by explaining the basic processes used for welding steel—metal-arc, Tig, Mig and submerged-arc.

No standard can completely cover or establish definite rules for selecting a welded joint, according to the AMF code pamphlet, because of numerous combinations available.

Five basic joint types—butt, corner, tee, edge and lap—plus the many different forms of edge preparation used separately or in combination, make it possible to have hundreds of different joint designs.

The AMF standards list some 28 different joints, ranging from a simple double-fillet lap joint to a chain intermittent fillet. Weldors are told to consult engineering and manufacturing departments whenever doubt exists as to which is best for any particular job.

Three Classes

Figure 1 is one of 10 charts published by AMF to represent good plate edge preparation and welding practice. The chart differs slightly from other published data, since it reflects advantages of recent developments in electrodes, equipment and welding techniques as compiled by the company.

All welds are grouped into three classes, although AMF's normal run of proprietary products rarely require Class I welds. These "X-ray quality welds" are used more often in applications involving high-tensile steels in heat-treated conditions, and for use under shock loads and with a low safety factor.

Since expensive radiographic inspection—and usually some repair welding—is involved to meet Class I weld standards, AMF states that design should be considered carefully before specifying such a weld. The company feels drawings should indicate any areas not requiring strict quality standards as outlined for this weld class.

Weld Inspection

All Class I welds at AMF are 100% inspected by radiograph and either a magnetic particle or dye penetrant test. When satisfactory quality becomes consistent in a specific welding job, AMF weldors may request permission from the engineering and quality control board to reduce the number of X-rays and/or the number of welds to be radiographed.

Any weld showing cracks, lack of penetration or fusion is rejected, but may be considered for re-welding by the company's material review board. Under-sized fillet welds, porosity and slag are acceptable in a Class I weld only if within the limits set by the AMF code.

Class II or "machinery welds" are usually specified for general structural welding and machine components where critical standards are not required. In this class, penetration depends on joint design and frequently is less than 100%.

Radiographic inspections are run on Class II welds if specifically requested and then only to establish the adequacy of welding techniques

Have you tried SEMI-AUTOMATIC HARD-FACING with STOODY WIRES?

Semi-automatic hard-facing is fast taking hold in all industry! Here's a process that *removes much of the labor of welding* and is 2 to 4 times *faster* than manual application. Weldors can see the weld—wires are fed bare; no submerging flux or flux dams are required. Welding is continuous, feeding from layer wound coils...no stub ends, no lost time changing electrodes. With higher speed there is lower heat input, less penetration of the base metal and reduced dilution of deposits...hence higher wear resistance than with manual electrodes of similar analysis.

WHAT CAN YOU HARD-FACE SEMI-AUTOMATICALLY?

Virtually all large parts now hard-faced manually ...crusher rolls, mill hammers, impact crusher rotors, shovel and tractor parts, tool joints, dredge pump impellers and casings, muller tires, etc.

ASK FOR DEMONSTRATION—Most Stoody distributors (check the yellow pages of your phone book) are equipped to demonstrate Stoody Semi-Automatic Hard-Facing *right on your job!* Ask your distributor to arrange a demonstration today!

STOODY SEMI-AUTOMATIC WIRES—Now available in 11 types for *maximum* wear resistance under *every* wear condition!

STOODY COMPANY
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used. When welding "difficult" materials or those with which the AMF shop has had no previous experience, the welds are radiographed.

Heat Treated

Welds to be heat treated are given 100% magnetic particle or dye penetrant inspections. Welds not to be heat treated are given a percentage magnetic particle or dye penetrant inspection.

Percentage is stated by AMF's engineering department on its operation sheet. The amount of cumulate undercuts, porosity and slag allowed is 50% greater than for a Class I weld.

Non-critical welds, such as chain guards, hoppers, tubular roller ends and assembly fixtures, may use a Class III weld. Although no inspections are run on these welds, the AMF quality control board may reject any weld containing excessive surface irregularities. All rejections in these latter two classes may also be considered for re-welding by the company's material review board.

General Design

To combat a tendency to "over design," AMF standards also provide for individual examination of every joint "to establish *(1)* class or quality of welds actually required, *(2)* minimum amount of edge preparation needed to satisfy fuctional requirements, and *(3)* extent to which intermittent welding can be employed."

The company also found a tendency to specify continuous welds for the entire joint length, which often were not necessary and caused distortion. Intermittent welding combined with continuous welding where practical is the solution as set by AMF standards. Costs can often be reduced in this manner.

Joint design is influenced by several general factors such as penetration percentage required, material thickness, part size or fragility, accessibility for welding and welding process to be used.

Weld Penetration

Penetration is related to metal thickness and fit-up of the parts being welded. When greater penetration is required on a particular AMF job, parts to be welded are usually beveled, to provide clearance for the electrode down to the point of initial fusion. The first pass is sometimes made with a smaller wire or electrode than used in subsequent passes.

The object is to obtain fusion at the point where the parts touch. The remainder of the joint is filled with the least number of passes possible by using a larger electrode. Penetration and fusion depth in a beveled joint will vary according to the bevel or groove design. The wider the groove is at the bottom, the greater the root penetration.

For economy the company standards suggest beveling be no deeper than design factors demand, since complete penetration is not always necessary. But welded joints to be machined must be beveled deep enough to provide adequate joint strength after machining.

AMF realizes full penetration can be obtained only by welding from both sides or by using back-up strips or rings. But since tubular structures can be welded from one side only, any attempt to obtain 100% penetration will result in holes burned through the tube.

Use of Back-ups

Therefore, when back-up rings can be placed inside tubular joints, supplying ample heat for 100% penetration, AMF weldors are encouraged to do so.

Permanent back-ups are usually specified only when located so that they cannot be removed after welding. Detailed drawings are then made of the back-ups, which are the same material as the parts to be welded. When back-ups can be removed after welding, they are usually made of copper to prevent fusion with the parts, and are considered part of the tooling.

The standards further provide that removable back-ups for butt welds, such as longitudinal cylinder seams, have a shallow clearance-cut machined in them to provide room for weld metal penetration. For fillet welds requiring 100% penetration, where one joint side is inaccessible for welding, the removable copper back-up is beveled. Root gaps are also used to facilitate penetration.

Preheating Steels

Joints welded from both sides may or may not have perfect penetration. When complete penetration is required, AMF standards suggest that part of the first pass be root chipped into sound metal (generally with an air-operated chip hammer, a grinding wheel or arc-air torch).

Preheating of low carbon steel is usually not required, but high carbon and alloy steels are preheated to insure sound welds. These steels will harden at the fusion line during welding and develop possible cracks or produce machining difficulties. AMF standards divide the steels into four groups and give approximate preheating temperatures for each, ranging between 100 and 600 F.

Postheating or stress relieving is often employed by the company to insure distortion-free welds during and after machining.

Stress Relieving

As a general AMF rule, stress relieving is specified on any steel subject to weld hardening and cracking. Most welds made with low alloy

			FOR CLASS I or II WELDS (WELDED FROM ONE SIDE)		FOR CLASS I or II WELDS (ROOT CHIPPED AND WELDED FROM BOTH SIDES)	
PLATE THICKNESS	L	ELECTRODE DIAMETER NOTE 1	NUMBER OF PASSES NOTE 1	LBS. OF ELECTRODE PER FOOT OF WELD NOTE 1	NUMBER OF PASSES NOTE 1	LBS. OF ELECTRODE PER FOOT OF WELD NOTE 1
1/8	1/32	3/32	1	.02	-	-
3/16	1/32	3/32	1	.05	-	-
1/4	1/32	1/8	1	.11	-	-
5/16	1/16	3/16	1	.17	-	-
3/8	1/16	1/8	1	.09	2	.19
		3/16	1	.16	1	.16
1/2	1/16	1/8	1	.09	2	.19
		3/16	2	.43	2	.43
5/8	3/32	1/8	1	.09	2	.19
		1/4	2	.66	2	.66

FIG. 1: Chart given as a guide for estimating costs and setting time standards for single-bevel butt welds.

new! SuperGrip holder

by

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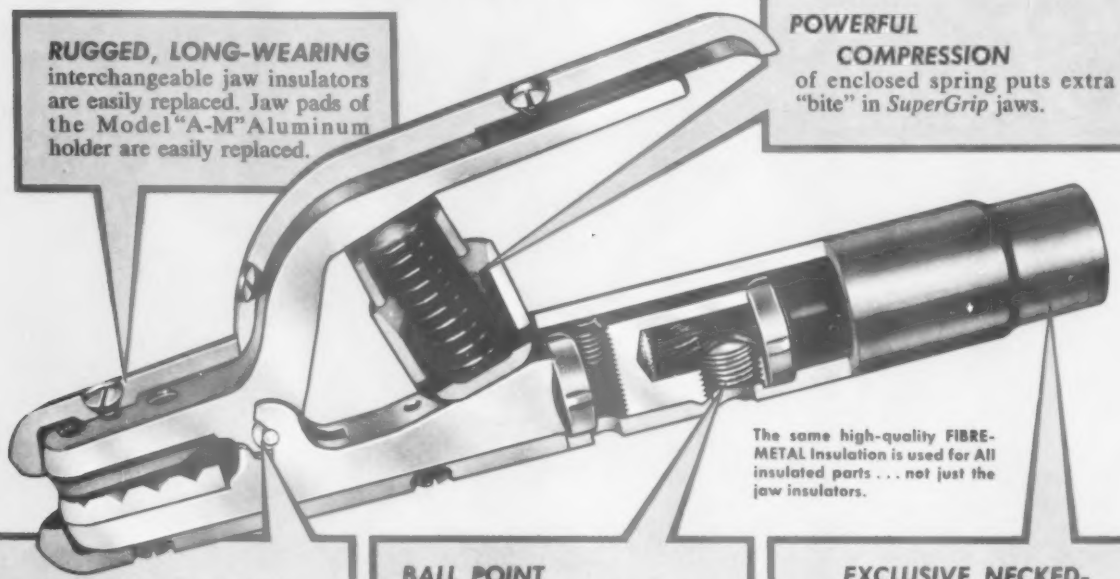
PRODUCT OF OVER 50 YEARS OF WELDING EXPERIENCE

THESE OUTSTANDING SuperGrip® FEATURES MAKE WELDING SAFER, EASIER, MORE ECONOMICAL!



RUGGED, LONG-WEARING interchangeable jaw insulators are easily replaced. Jaw pads of the Model "A-M" Aluminum holder are easily replaced.

POWERFUL COMPRESSION of enclosed spring puts extra "bite" in *SuperGrip* jaws.

The same high-quality FIBRE-METAL Insulation is used for All insulated parts . . . not just the jaw insulators.

PERMANENT PIVOT BUSHING in tongue of trigger assures alignment, minimizes wear and increases service life of the Model "A-M" Aluminum holder for lowest cost.

BALL POINT SET SCREW of "man-size" diameter really *grips* cable tightly . . . can be tightened without removing handle . . . provides maximum current-conducting cross section.

EXCLUSIVE NECKED-DOWN HANDLE cuts "cable fatigue" by reducing cable play at handle end and close to the cable connection . . . to effectively prevent fraying and fatigue of wire strands.

SuperGrip*®** is *the* Welding Electrode Holder designed to eliminate not just one or two, *but EVERY* awkward, irritating, troublesome design point ever built into an ordinary electrode holder! No more frayed cables! No more overheated holders! ***Now you get the neat, compact design that increases maneuverability and minimizes welding work fatigue!

At every vital point . . . bushed pivot pin, long-wearing jaw surfaces, powerful spring, securely anchored cable, reduced cable play . . . *SuperGrip* approaches the ultimate in Welding Electrode Holder design. *Ask your welding distributor for a SuperGrip today!*

4 *SuperGrip*® *Models cover the complete range of normally-encountered welding operations and currents:*

Model "A-M" | Model "C-S" | Model "C-M" | Model "C-L"

Model	Material	Capacity	Max. Electrode Dia.
"A-M"	Aluminum	300 Amps.	1/4"
"C-S"	Copper Alloy	250 Amps.	7/32"
"C-M"	Copper Alloy	300 Amps.	1/4"
"C-L"	Copper Alloy	500 Amps.	3/8"

THE FIBRE-METAL PRODUCTS COMPANY

CHESTER, PENNSYLVANIA—*In CANADA: Fibre-Metal (Canada) Limited, Toronto*

THE WORLD'S LARGEST MANUFACTURER OF WELDING EQUIPMENT

electrodes are stress relieved, specified on the drawing when required.

Stress relieving may be requested on the operational sheet for a low carbon steel weld, if configuration and dimensional tolerances show a likelihood of distortion during and after machining.

After the weldment is heated to the stress relieving temperature (1,150 ±25 F), the temperature is maintained one hour for each inch —or fractional inch—of the maximum plate thickness, then furnace-cooled to 300 F.

To avoid harmful stresses due to temperature gradients within heavy sections, or heavy sections and adjacent light sections, temperature is raised and lowered at the following rate per hour: 200 F for 1 in., 150 for 2 in. and 100 for 3 in. Corrosion resisting steel welds are not stress relieved.

Welding Symbols

Welding symbols are a means of placing complete welding information on drawings. Those used by AMF were developed by the American Welding Society and adopted by the American Standards Association.

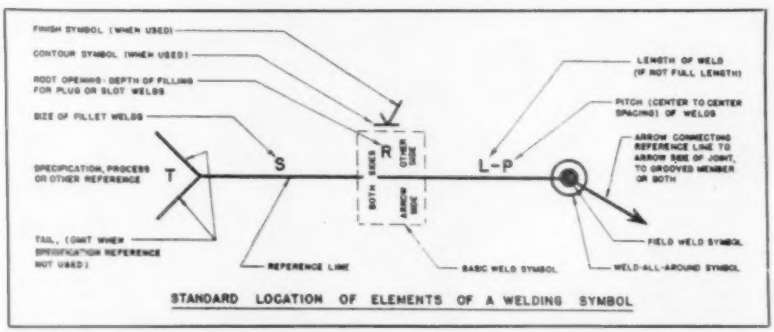
The AMF standards distinguish between *weld* symbol and *welding* symbol. Weld symbol indicates the desired type of weld—bead, fillet, etc. The welding symbol is a combination of reference line, arrow, basic weld symbols, dimensions, supplementary symbols, finish symbols, tail and specifications as shown in the figure. The AMF standards contain an entire section on application of welding symbols.

The company requires outside welding contractors to submit specimens before proceeding with any contract work. Depending on the nature of the welds, the engineering or methods departments may specify any test welds to demonstrate the contractor's ability to do an adequate job. Three basic tests are used; tensile, bend and fillet.

Pressure Tightness

Pressure tightness is specified by the AMF engineering department in terms of test pressure to be applied to those weldments which will contain gases or liquids under pressure. In critical cases the stated test pressure is not allowed to fall below a certain amount in a given time.

For low pressure applications, test pressure is never less than 15 psi unless the weld is too fragile. Leaks, which might be passed over under lesser pressures, can easily be seen under this amount.


FINISH SYMBOL (WHEN USED)
CONTOUR SYMBOL (WHEN USED)
ROOT OPENING; DEPTH OF FILLING FOR PLUG OR SLOT WELDS
SIZE OF FILLET WELDS
SPECIFICATION, PROCESS OR OTHER REFERENCE
T
S
R
L-P
LENGTH OF WELD (IF NOT FULL LENGTH)
PITCH (CENTER TO CENTER SPACING) OF WELDS
ARROW CONNECTING REFERENCE LINE TO ARROW SIDE OF JOINT, TO GROOVED MEMBER OR BOTH
ARROW SIDE
OTHER SIDE
BOTH SIDES
TAIL (OMIT WHEN SPECIFICATION REFERENCE NOT USED)
REFERENCE LINE
BASIC WELD SYMBOL
FIELD WELD SYMBOL
WELD-ALL-AROUND SYMBOL

STANDARD LOCATION OF ELEMENTS OF A WELDING SYMBOL

The company also has jobs in which the weld joint must be leak-proof for other reasons. For example, tubular structures which will be immersed in cleaning, plating or other finishing solutions, must be leak-proof to prevent seepage of acids or chemicals into the structure.

To avoid such seepage, the AMF standards provide for pressure testing of all welds in tubular structures. Holes ⅛-in.-diameter are drilled at all points of intersection, so as to produce a continuous air passage through all members of the structure.

A ⅛-in. pipe thread is then provided at some convenient point for attachment of an air hose. By applying air pressure of approximately 15 lb, each weld is explored for leaks. After repairing all leaks, the pipe thread is plug welded. All pressure testing is done in three ways; air, freon and hydrostatic pressures.

Other sections of the AMF standards deal with general rules for choosing electrodes, welding processes and specific rules concerning welds.

X-RAY WELDS ARE EASY

with the new P&H AP-100 Mild-Steel Electrode

The P&H AP-100—a brand new all-purpose, all-position E-6010 electrode—provides the vastly improved welding quality and ease of handling that welders like. Arc force stays constant and will not snuff out even when whipping the electrode.

Vertical welds are easier and free from holes. Beads are smooth and evenly rippled — possess excellent mechanical properties. For more information, write to Dept. 304B, Harnischfeger Corp., Milwaukee 46, Wisconsin.

HARNISCHFEGER
P&H WELDERS • ELECTRODES POSITIONERS

Aluminum diet reduces concrete mixer

HOWARD Adkins *(left)* demonstrates a fine point of Mig and Tig welding to Donovan Howlett *(center)* and Richard Hunt.

JOINING two cone sections, a weldor carefully examines his work. Mixer is now undergoing rigorous field tests.

THERE'S NOTHING NEW under the sun? Maybe . . . but did you ever see a concrete mixer made of *aluminum?*

If you haven't, you may see one soon because Kaiser Aluminum & Chemical Corp. has joined with Construction Machinery Co., Waterloo, Iowa, to fabricate such an innovation. Naturally, welding is the prime means of joining.

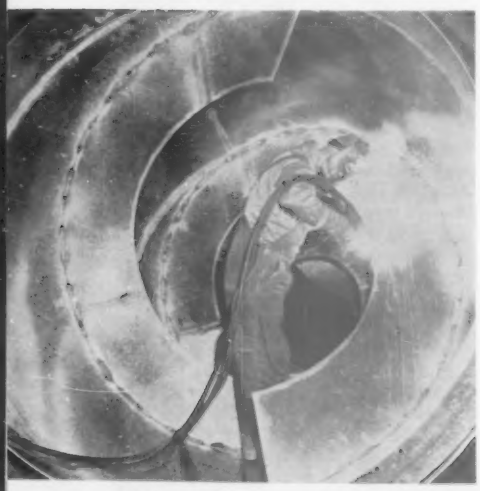
Don't expect to watch it trundling down the road in the near future, however, because this is just an experimental model. Both companies obviously hope to succeed with such a development, but the aluminum "Transcrete" was primarily built to learn whether aluminum could take the beating that steel concrete mixers receive.

Why leave steel and go to aluminum for a mixer? Weight is the answer. An aluminum mixer can carry more concrete, yet stay within legal weight limits.

Lighter weight will also slash gasoline, labor, and maintenance costs. The mixer will have a 7-yd capacity —a heavy load to carry—but the welded-aluminum construction will drop its heft well below that of a similar steel fabrication.

After being exhibited at the Nation Ready-Mixed Concrete Show in February, the Transcrete was taken out and run through grueling tests planned to make it or break it.

But the switch in materials made no difference in design. The same plans were used for the aluminum that were used for steel. The aluminum is pressed and roll-formed types 5083 and 5086 (with some 6061) developed by Kaiser to have high impact and abrasion resistance.



WELDING progressive spiraling on inside of mixer. Note intermittent welds along side wall joints.

Learn as You Go

To demonstrate welding of the aluminum, Howard Adkins, Kaiser welding specialist, travelled to Waterloo. His pupils were Richard Hunt and Donovan Howlett, who learned the in's and out's of Mig (Metal inert-gas) and Tig (Tungsten inert-gas) aluminum welding.

For a day and a half, Adkins drilled the two men in techniques new to them before turning them loose on the job. For welding the 3/16-in. to ¼-in.-thick plate on the round drum, weldors used 5356 filler wire for both Mig and Tig welds.

This was 1/16-in.-dia. wire and was used with a constant-potential power source set at 26-28 volts and 175-250 amp. Shielding gas was argon, which fed at 45 to 50 cu ft per hour.

The frame to support the drum is comprised of channels welded into Z-members. Intermittent welds were made—about 8 in. long on 14-in. centers.

The stub shaft (i.e., the shaft which revolves the drum) was formed of 6061 T6 aluminum. To this were welded the fins, or gussets. This was a very critical job because weldors had to be sure not to disturb the material's heat treatment in any way.

Except for the rolled rings of steel to bind the drum and the drive train, all other fabrication is of aluminum.

Weld Types

Most of the welds are butt joints, although fillets are used on the drum's spiral inner blades. Butt welds are made on both sides of the joint. One pass is made on each side, but the underside bead is not laid until the first one is back-chipped with a mechanical hammer.

Inside the drum, ⅜-in.-thick blades are needed to continually agitate the concrete. Joining the blades to drum, weldors used fillet welds. These were intermittent fillets laid back-to-back. This blade, when welded, can handle the stiffest mixes without showing strain.

If the Transcrete wins through its rugged testing, we may see aluminum concrete mixers with the same capacity and strength as steel, but which weigh much less.

Tempilstik°. . . . temperature indicating crayons

■ TEMPILSTIKS° provide a simple and accurate means of determining preheating and stress relieving temperatures in welding operations. Tempilstiks° are widely used as a standard method of checking temperatures in all heat treating—as well as in hundreds of other heat-dependent processes in industry. Available in 67 different temperature ratings . . . . . $2.00 each.

Most leading welding supply houses carry Tempilstiks°.

If yours is among the few that do not as yet, then write direct to us for further information.

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WELDS WON'T CRACK

with P&H Low-Hydrogen Electrodes

Weld difficult steels with little or no pre-heat — and at less cost. P&H Low-Hydrogen Electrodes are free of hydrogen forming minerals. The result: superior X-ray welds without underbead cracks or porosity.

Electrodes match chemical and heat-treating analyses of many alloy steels. You get higher heats for faster deposition — better impact over a wide temperature range — and easier handling. "As welded" tensile strength up to 275,000 lbs. psi. Get Bulletin R-29. Write Dept. 314B, Harnischfeger Corp., Milwaukee 46, Wis.

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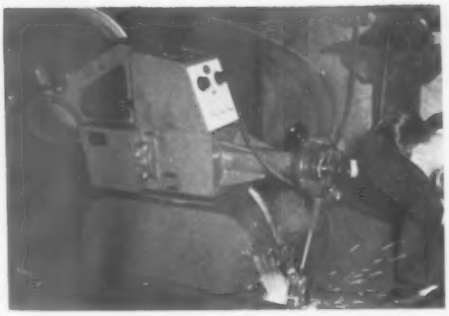


WORKER checks gas-shielded weld made by self-propelled head. Electrode is feed from drum-type fitting at rear. Gas hose and power pack cable are led to machine together.

CO_2 plus special electrode

New welding method acclaimed by British

By William A. Heath

A NEW GAS-SHIELDED automatic welding process has recently been introduced by Britain's Quasi-Arc Ltd. Finding wide acceptance in British shipyards, the process combines a continuous coated electrode and a carbon dioxide gas shield.

Two main reasons for its acceptance are higher weld speeds as compared to submerged-arc methods, and high metallurgical standards of the weld metals.

A specially developed electrode is used for horizontal, vertical and flat-position welding, as well as single- and multi-pass butt welds.

Weld Tests

Tested weld metal specimens show good mechanical properties. Tensile tests proved the yield point to be 61,600 psi and ultimate stress, 71,000 psi. Elongation was 32% and area reduction was 70%. Izod value after impact testing was 51 ft/lb. No signs of failure showed after specimens were bent through 180 deg over a form that was twice the specimen diameter.

Although weld metal is a low-hydrogen type, the electrode gives a smooth easy-to-control arc because of its rutile coating. At high currents there is little spatter, and de-slagging is easy even when maximum currents are used.

A typical analysis of undiluted weld metal is: carbon, 0.06%; sulpher and phosphorus, each 0.03%; manganese, 0.80%; silicon, 0.25%; and nitrogen, 0.01%. The shield prevents any carbon pick-up in the weld metal. Butt welds, made under a wide range of welding conditions, were free of internal defects.

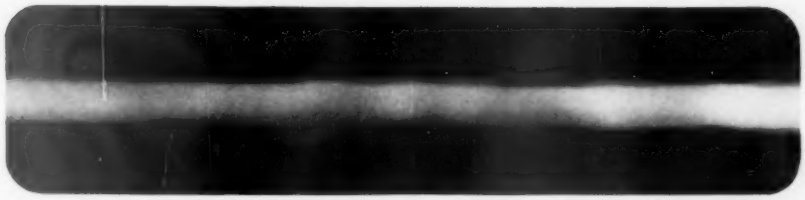
High Penetration

Because of high penetration, smaller than usual fillets can give equivalent strength and increase weld speed. Horizontal and vertical fillets in rim steel tested out equal to semi- and fully-killed steels.

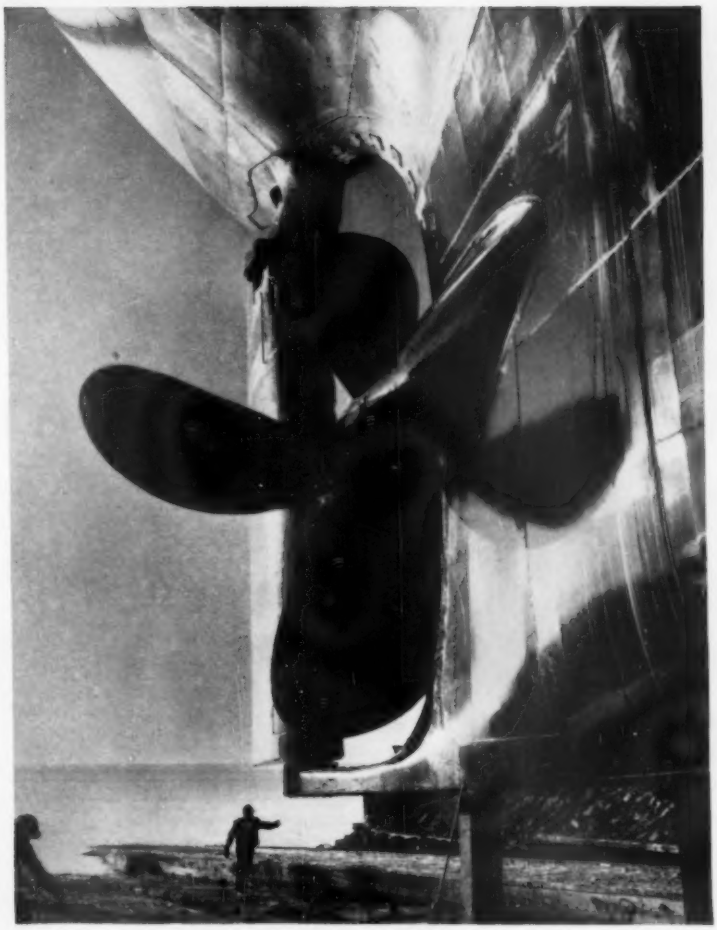
Good control of penetration also makes square-edge butt welds possible on $\frac{1}{8}$-in. to $\frac{3}{4}$-in. plate as well as single-and multi-pass welds.

Shielding gas flows at 25 cu ft per hour and need not be increased to more than 30 cu ft per hour for inside use. Greater gas flow is required to protect the arc in moderate winds. Local windbreaks and increased gas flow are needed in high winds.

Two cylinders with gas manifold and heated regulator are standard equipment. Maximum electrode feed and traverse speeds range up to 100 ipm. The welding heads are designed to operate at these speeds with currents up to 1,400 amp. Both self-propelled and stationary heads can be used.



Heavy sections like rudder posts and propeller blades can be gamma ray inspected with ⅓ shorter exposure—and welded seams can be radiographed more rapidly with available portable or low kv x-ray equipment—when Kodak Industrial X-ray Film Type KK is used.



. . . cut exposure time 1/3 with New Kodak Industrial X-ray Film TYPE KK

Where heavier sections are to be radiographed or where the output of available x-ray or gamma ray sources is limited, Kodak's new Industrial X-ray Film Type KK is the film to use.

This film shows as much as 50% increase in speed over the well-known Type K Film. It means more work can be done—that exposures can be cut by a third. And those who have tried Type KK tell us that its higher contrast, offsetting a slight increase in graininess, provides improved radiographic sensitivity.

To learn how Kodak Industrial X-ray Film Type KK can extend the service of your present radiographic equipment, get in touch with your x-ray dealer or Kodak Technical Representative.

EASTMAN KODAK COMPANY
***X-ray Division*, Rochester 4, N.Y.**

Kodak
TRADE MARK

NEW

Levermatic
WELDING TORCH

- **SAVES TIME**
- **SAVES GAS**
- **REDUCES FATIGUE**
- **CUTS COST**

Dockson again leads the field with the first real improvement in welding torch design in years. The "Levermatic" was designed especially for improved operating efficiency and comfort. Once adjusted to the operators satisfaction it can be turned off and on with the flick of a thumb, always in identical adjustment.

Light pressure on the lever increases flame from pilot to work adjustment and locks in position—a flick and its back to pilot. No cramping hand tension. No readjusting or relighting. No wasted gas. It takes the fuss and fumble out of welding.

There's a Dockson Distributor near you. Ask him to demonstrate the "Levermatic" in your shop.

Dockson has a complete line of quality welding and cutting equipment for every use. Ask for our new Welding Catalog No. 58W.

LEVERMATIC
MODEL 3E
For light to one inch welding,
Length 18".

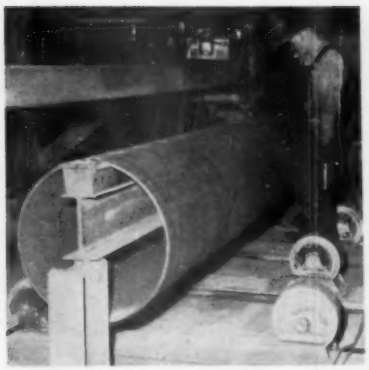
LEVERMATIC MODEL 3BB
For light to one inch welding,
Length 13".

LEVERMATIC MODEL 3EV
For light welding, Length 13".

Dockson CORPORATION

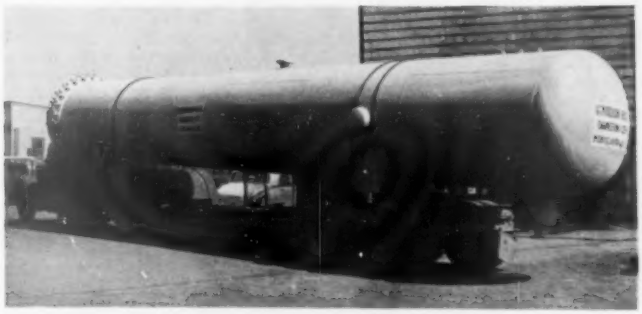
3339 WABASH AVENUE • DETROIT 8, MICHIGAN

HOSE lying in channel beneath longitudinal seam of large-diameter pipe column forces flux against seam when filld with air.



AUTOMATIC submerged-arc unit running on long beam finishes seam. Pipe columns will serve as legs for 400,000-gal tank.

HUGE girder gets simultaneous submerged-arc welds on both sides of web-to-flange seam. Four welders were used on 139-ft job.



LEFT: This all-welded pressure vessel is destined for a wood treatment plant. RIGHT: Gunderson puts stud welding to good use. These thick studs are being welded with 2000-amp power source.

Welding heavy steel

By Howard E. Jackson

GUNDERSON BROS. Engineering Corp. of Portland, Ore., welds a variety of fabricated steel items that can only be classified as "big stuff"— spillway gates, penstocks and stoplogs, for instance. Obviously, only a high degree of welding know-how makes such specialization possible.

Three of the largest tainter gates in the world were fabricated in the Gunderson shop, and they successfully met the strict tolerance requirements of the U. S. Corps of Engineers. Each gate measured 46 ft in length and weighed 88 tons!

But that was only one of many heavyweight jobs. The Portland firm also fabricates and erects steel for modern buildings and bridges; it welds marine craft, retorts, tank trucks and trailers, storage tanks, and sawmills.

Favor Submerged-Arc

Wherever possible, Gunderson uses the submerged-arc or the magnetic flux gas-shielded welding processes. But they also employ the manual metal-arc process extensively, and find many applications for Mig welding.

One of the most recent jobs to which the submerged-arc process was applied was the welding of two Z-bars for center sills on refrigerator car underframes. The bars had a chamfer of $6\frac{3}{8}$ in. in 52 ft, and were bent by jacks over a jig on a cart. The cart was then pulled past two welding heads.

Flux was used instead of a copper bar for back-up on this welding operation. A hose was placed in a channel beneath the Z-bars, covered with an asbestos pad, and the channel was then filled with flux. When air was forced into the hose, it expanded to force flux tightly against the underside of all joints. The $\frac{1}{2}$-in.-thick Z-bars, welded at a speed of 16 to 18 in. per minute, turned out perfectly and did not require straightening.

80-Ft Girders

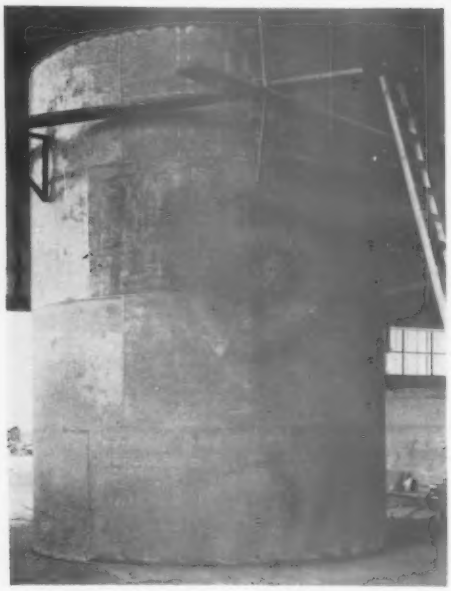
Another big submerged-arc job is the fabrication of 80-ft girders which serve as frames for railroad flatcars used in "piggy-back" hauling of truck trailers.

Plates for webs and flanges, in 20-ft lengths, are horizontally positioned for welding. Slots are flame-cut in web plates to provide hook-up points when van bodies are placed aboard railcars. Welding on each girder section is then carried out at a speed of 16-18 ipm.

But these are not the longest girders fabricated by Gunderson. Some, for use in bridge construction, must be welded in lengths up to 90 ft, and plate thickness for such girders varies from 5/16 to 2 in.

An automatic flame-cutting machine with an electronic tracing device makes the job of sizing plates a relatively easy one for the firm. Black and white plastic templates laid out on a table adjacent to the flame-cutter provide

SOME of Gunderson's heavier fabrication jobs are represented by the partially completed tug boat hull at right, and the all-welded water tank below.



LEFT: Magnetic-flux gas-shielded process is used here to weld stiffeners to this bridge girder. The firm has five of these CO_2-shielded welding units.

RIGHT: Operator adjusts heights of one of nine torches being used to flame-cut small parts from this ½-in. steel plate.

an accurate guide for torch control.

Mounted on tracks above the plate to be cut, the flame-cutter can slice through ½ and ⅝-in.-thick material at a rate of 17 ipm. When the cutting operation is complete, webs and flanges are positioned and tack welded with manual arc equipment.

Preventing Distortion

The complete web-to-flange seam is welded by a dual-head submerged-arc machine. A carriage resembling a flatcar carries the girder assembly past the heads for this simultaneous welding application that prevents distortion. Welding speed is 23-28 ipm and a ¼-in. weld bead is laid down.

Biggest of all jobs attempted by Gunderson with a submerged-arc unit was the fabrication of a 139-ft-long bridge beam. This beam had to be hauled away on two trucks.

Four automatic welding heads were used for this application—one on either side of the beam at one end, and a similar set-up at the middle of the beam. These heads remained stationary while the beam was carried between them on carts.

Since one set of welding heads joined the bottom web-to-flange seam, and the other welded the top seam, the beam simply had to be reversed at the end of the run and sent back for completion of the welds. Amount of space needed for beam travel therefore, amounted to only half its total length.

Rolling Big Pipe

There are five acres of floor space available under one roof at the Gunderson plant—and large chunks of this area must be commandeered daily for jobs such as the rolling of large-diameter pipe.

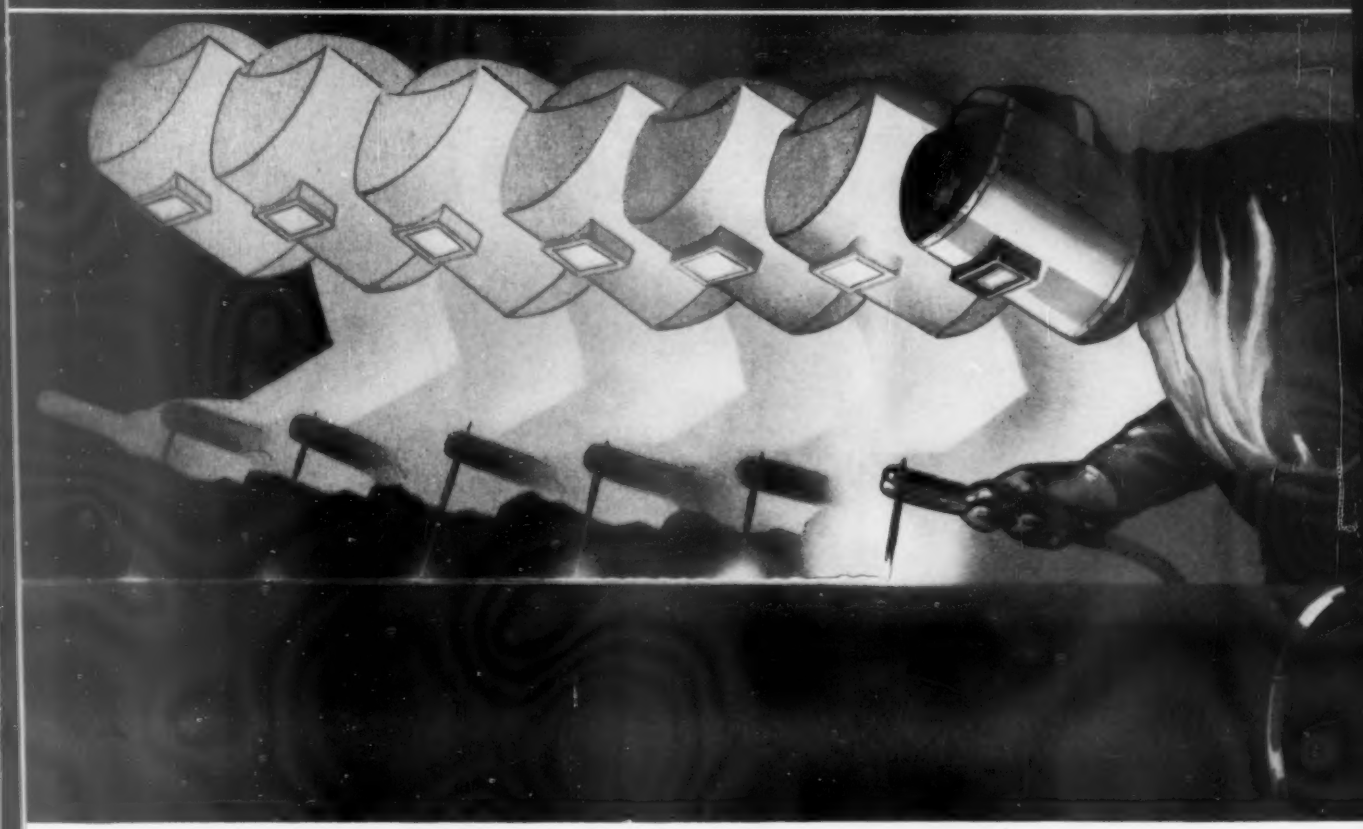
The firm regularly fabricates 15-ft 4-in.-diameter syphon pipe in 48-ft-long sections, and here again, submerged-arc is the favored welding process.

Layout for this pipe is comprised of 16 plates, each 6 ft wide and 24 ft long. When placed so that all seams are butted over back-up bars, the plates form a 48-ft square. A self-propelled submerged-arc unit then welds all joints, and the plate is flopped for rolling.

Four steel rims are placed on the welded plate, which is then pulled up and over them until edges meet. This last seam is submerged-arc welded on its interior side. The forming rims are left in the finished pipe section so that it will hold its shape during shipment.

Lending a helping hand in this job is an overhead crane rated at 45-ton capacity. It is just one of dozens of mobile and overhead types that are classified as vital equipment in a plant that thinks and welds BIG.

NEW MUREX® IRON POWDER "Hot Rod"



SPEEDEX TRIPLEX

another NEW product

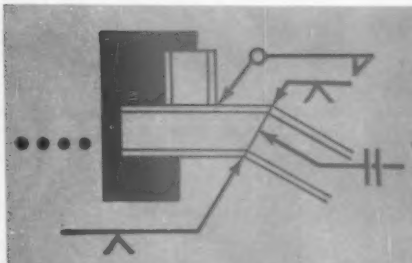
matches deposit rates of automatic welding..

Manual welding speeds as much as 40% faster than competing electrodes—deposit rates up to 16 lbs. of weld metal an hour—have been obtained in actual tests with TRIPLEX, the new Murex iron powder electrode. Designed for high speed downhand welding with either drag or open arc technique, it produces X-ray quality welds with ultimate strengths of 62,000 to 66,000 psi and elongations of 30 to 33%.

SPEEDEX TRIPLEX offers all the usual advantages of iron powder electrodes. It has good arc characteristics and an easily removed slag. In addition it operates equally well on AC or DC and, in the ¼" diameter, at currents up to 450 amps. It is by far the fastest of the MUREX SPEEDEX line and is especially suited to the welding of large fabrications such as ship sections, freight cars, machine frames and pressure vessels.

Write for specific information on SPEEDEX TRIPLEX. Ask, too, for Folder IP-57 describing the entire SPEEDEX iron powder line.

METAL & THERMIT CORPORATION
Rahway, New Jersey



the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Welding galvanized steel and soldering stainless

Question:

When soft soldering stainless steel, I use concentrated hydrochloric acid as a cleaning agent. However, there is still a lack of complete bonding between the soft solder and the stainless. Would you suggest the correct chemical mixture I should use?

Answer:

Both 18-8 and straight chrome stainless steel are readily soldered. Although you do not specify what type stainless you are working with, the composition will have no effect on the finished joint.

If your metal has been pickled, either zinc chloride or cut acid will give fair results with half-and-half solder. You will get stronger joints, however, if you use a special soldering flux.

Prepare the stainless for soldering by roughening the edges if the metal is polished. A course file or abrasive cloth will help give you the necessary adhesive surface.

Use a large soldering iron with temperatures as low as possible. Warpage will be held to a minimum in this way.

After soldering, wash the joint in a solution of about 5% soda. Washing will remove any acids which might corrode the metal. In some circumstances, especially with units which cannot be washed on both sides, the joint should first be tinned with a strong flux, then washed before assembling.

After assembly, finish soldering the joint with a neutral flux which, even if it is not totally removed when soldering is completed, at least will not corrode the stainless.

Question:

I would like to resistance weld some galvanized steel for tanks. But I am afraid the zinc's low melting point will cause it to be burned away during welding. Is there anything I can do to prevent this from happening?

Answer:

You can make successful welds on galvanized steel if you exercise care. Zinc, which has a melting point around 780 F and a boiling point of 1,660 F, is affected by the heat generated by resistance welding and therefore must be approached cautiously.

When a spot weld is made, for example, the surge of current melts the zinc. But if current settings are correct, the metal will melt from the interface and form a seal around the weld nugget. An excess of zinc flow is undesirable; you can avoid this by making practice welds.

Take a scrap piece of the same material you plan to work with. Make several welds at much lower currents than you plan to use on the job.

When your electrode—which should be a Class I type—takes on a gray or black zinc coating, set your current at the desired value and begin welding. Water cooling is recommended.

Finding your weld settings may be somewhat difficult. This is due to variations in thicknesses of the zinc coating. However, resistance welding experts at Sciaky Bros., Inc., of Chicago, recommend using higher currents, higher electrode pressures and shorter weld times than you would on low-carbon steel of the same thickness.

If your settings and technique are correct, your welds will have a uniform gray appearance. You can get extra protection against corrosion by covering the welds with aluminum paint.

Seam welds will be even harder to make. The difficulty here is that residual heat cannot be conducted away fast enough to prevent melting the zinc on the outer galvanized surfaces. Any welds you make must be coated with aluminum paint to resist corrosion.

In flash-butt welding, you will definitely lose your galvanization. Your only recourse is to weld—then unlimber that aluminum paint can again.

Your best bet is projection welding. Because projections on the metal concentrate heat at point of contact, large-area electrodes can be used. In this way, you reduce current density between electrode and metal surface and, accordingly, reduce heat.

In addition to reducing heat, you avoid electrode pick-up and weld cleaning usually is unnecessary. As in spot welding, the zinc melts at the interface and envelops the weld nugget.

The Editors will make every effort to answer all questions submitted to this department. If you have a question concerning welding or related processes—or a tip you would like to pass along to other readers—send it to *The Welding Clinic.*

Picker "CYCLOPS"

will radiograph **6 inch** steel in **15 minutes**

costs under **$20,000**

operates anywhere

time for other thicknesses	
2"	0.5 min
3"	1.2 min
4"	2.8 min
5"	6.0 min
6"	15 min
7"	33 min
8"	1.4 hrs

quick rundown on CYCLOPS

excellent detail sensitivity
1% and 2% radiographic sensitivity is routine

high energy
Cyclops holds a 1000 rhm source of Cobalt 60: its radiation is equivalent to 2-3 million volt x-rays

low first cost
Capital investment is under $20,000—less than one-quarter the cost of an equivalent supervoltage x-ray installation

low operating cost
No electronic or x-ray tubes: virtually no maintenance

self-contained mobility
Travels anywhere . . . easy to use even in the open at a construction site

completely safe
Engineered for safe operation under all conditions

Wheel "Cyclops" into action like this—then walk away. Start exposure electrically from a remote, fully protected position. *Come back in fifteen minutes and find the job done.*

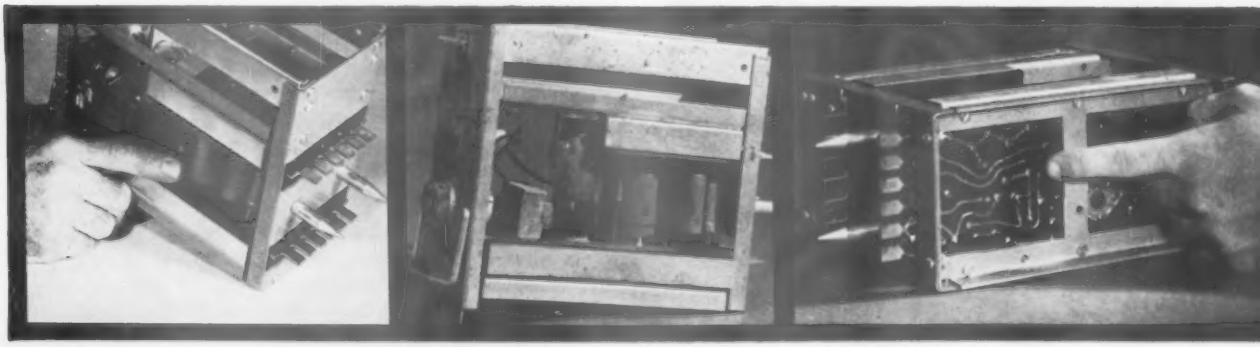
Cyclops is a "natural" for radiographing massive castings and weldments of steel, dense alloys, even solid lead inches thick.

Whatever the nature of your need for radiographic or fluoroscopic inspection, we probably have just the machine to do the job for you. The Picker spread of equipment spans the range from 10 KV x-rays (for paper-thin materials) to 2-3 MEV equivalent Cobalt 60 units.

For information and advice concerning any phase of radiation-utilization, contact any Picker District office (see local 'phone book). Or write, telephone or wire Picker X-Ray Corporation, 25 South Broadway, White Plains, N. Y.

If it has to do with radiation it has to do with Picker x-ray

NEW G-E RESISTANCE-WELDING CONTROLS come in two lines to meet *any* non-synchronous application. ***Standardline*** combinations—using standard NEMA sequence timers—are specifically for normal welding applications. ***Customline*** combinations use unit timers to provide any control sequence needed on special-purpose, multi-electrode, or automated machines.



4 **CIRCUMFERENTIAL ARRANGEMENT** of circuit components permits quick replacement and easy accessibility.

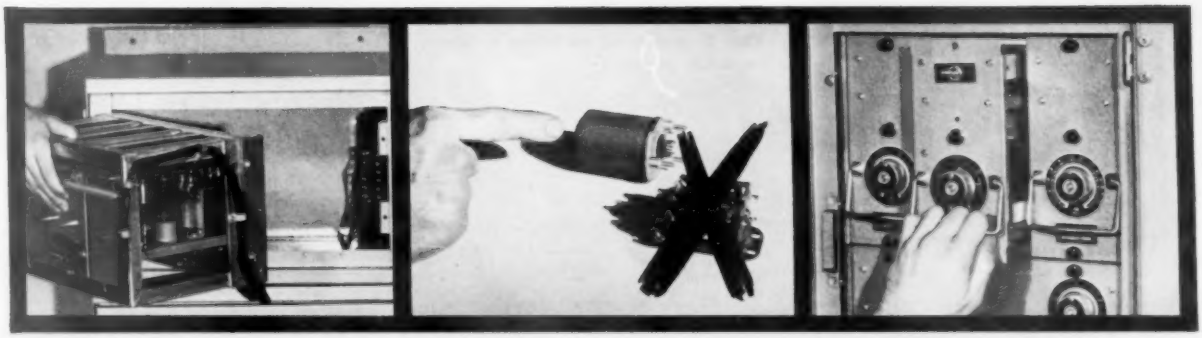
5 **RUGGED DESIGN** gives optimum resistance to adverse conditions such as dirt, moisture and vibration.

6 **NEW CIRCUITRY** provides greater accuracy, more consistency, and less sensitivity to line-voltage changes.

Specify General Electric's NEW *cost-cutting* non-synchronous controls for your next resistance-welding application. For more information, write to Section 794–2, General Electric Co., Schenectady, N. Y., for bulletins GEA-6408 (Standardline) and GEA-6593 (Customline). *Specialty Control Dept., Waynesboro, Virginia.*

7 REASONS WHY GENERAL ELECTRIC'S NEW NON-SYNCHRONOUS CONTROLS

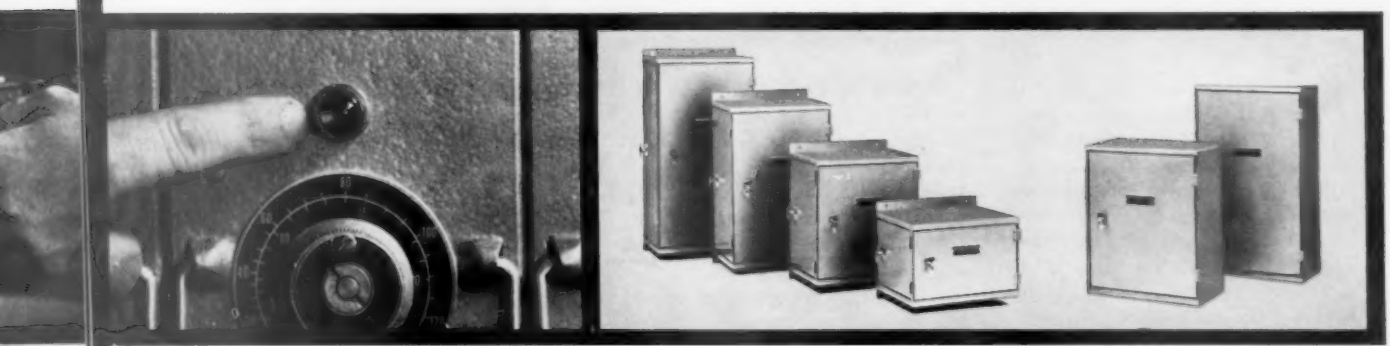
Cut your welding maintenance time and costs



1 **SWING-OUT FRAMES**—exclusive General Electric feature—speed installation, inspection and maintenance.

2 **SEALED RELAYS**—another G-E exclusive—give millions of operations and have a written one-year warranty.

3 **DRAWER-TYPE PLUG-IN UNITS**—used throughout—provide maximum flexibility, exchangeability of components.

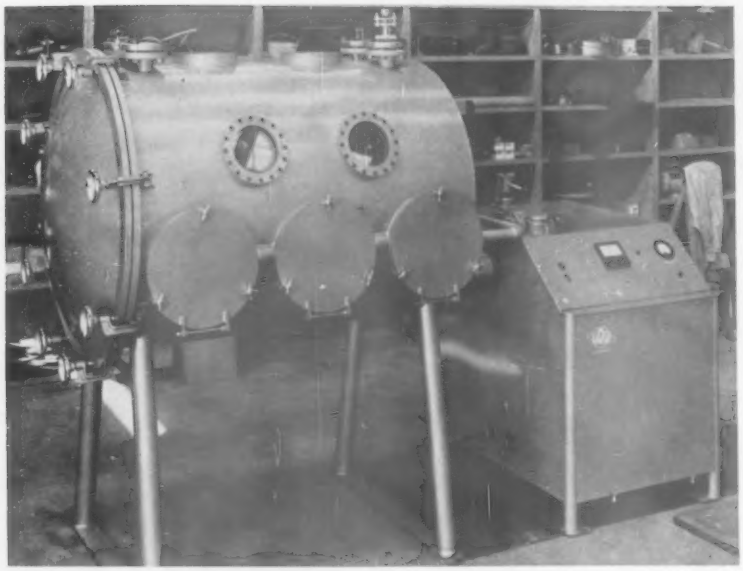


7 **OPERATIONAL INDICATING LIGHTS** spot and give visual indication of trouble, thereby reducing downtime.

FULL-LINE SELECTION—choice of 4 control cases and 2 contactor cases—means you can buy for present and future needs! "Building-block" design gives maximum flexibility for assembly of combinations, a simple way to add control.

Progress Is Our Most Important Product

GENERAL ELECTRIC



NEW L & B chamber with pumping console takes up minimum floor space. Interior shot (left) shows gloved portholes enabling weldors to reach work.

Top weld quality is assured in c-a chambers

NEAREST APPROACH to the ultimate in welding quality is given by the controlled-atmosphere vacuum welding system.

Key component of such a system is a chamber evacuated by a variety of pumps to give a relatively high vacuum. Once this condition is obtained, high-purity inert gas is introduced into the chamber and welding commences.

Two industries, nuclear and aircraft, have exerted the greatest influence in the application of controlled-atmosphere welding systems. Extreme corrosion problems encountered in the nuclear industry—plus the need for materials with low neutron absorption characteristics—create numerous situations where such materials as zirconium and zircaloy-2 must be welded under ideal conditions.

A demand for materials with high strength-to-weight ratios and the ability to retain strength at high temperatures has similarly directed aircraft manufacturers in the direction of controlled-atmosphere welding. Titanium and beryllium are two such materials in a fast-growing list.

A basic c-a system comprises only a chamber and a pumping console. To these fundamental items, however, can be added purification trains; power supplies; travel and rotational fixtures; airlocks; fully automatic operational controls and numerous other accessories.

Cost of a c-a system is determined by these requirements: ultimate vacuum; pump-down time; size of chamber; allowable leak rate and operational equipment.

Typical of controlled atmosphere installations now performing invaluable service for touchy welding operations is this new unit manufactured by L & B Welding Equipment, Inc., of Berkeley, Calif., and the unit described at right.

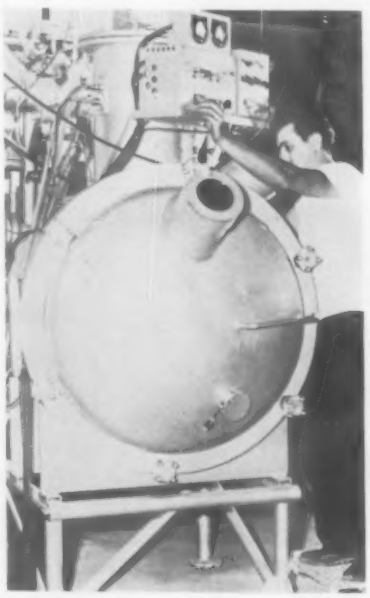
A new titanium alloy is used in fabricating pressure vessels reportedly lighter and stronger than stainless types.

Tig in a tank welds stronger titanium vessels

By Robert B. Stanton

A SEMIAUTOMATIC Tig (tungsten inert-gas) welding facility is enabling Titanium Fabricators, Inc., of Burbank, Calif., to construct pressure vessels with 6A1-4V titanium alloy. The new alloy was developed by Mallory-Sharon Titanium Corp.

The welded vessels are being used for compressed gas storage, and have the general advantage of being stronger, yet lighter, than compar-



TITANIUM parts are held by a mechanically-indexed fixture and rotated under a stationary tungsten electrode in this vacuum tank. Argon-helium shielding gas mixture is used and operator adjusts controls while viewing welding through observation port.

able stainless steel containers. Plate stock in a thickness range from 0.250 to 0.325 in. is used.

First step in the fabrication program is mechanical: circular blanks are cut with 16, 22 and 25-in. diameters. Blanks are then formed into hemispheres on a special hot-spinning lathe.

HEAT treating and aging is necessary for titanium pressure vessels because of stressed condition of parent metal and relative ductility of welds. Heating cycle is 1,500-1,700 F for 30 to 60 minutes, and is followed by water spray quench and aging at 800-1,000 F for 4 to 10 hours.

Vacuum-Tank Welds

After edges have been flame-scarfed or contour machined, hemispheres are cleaned and degreased for the circumferential Tig welding application.

Welding is performed in a vacuum tank so that the argon and helium shielding gas mixture can do the best possible job of preventing oxidation. A mechanically-indexed fixture within the chamber holds and rotates the parts in pairs while their edges are fused with a stationary tungsten electrode.

Two ports in the side of the chamber allow a weldor to observe all stages of the joining operation, and to make necessary control adjustments for best possible results.

Arc-length adjustments are perhaps most essential to the production of acceptable welds in titanium pressure vessels. The unit used by Titanium Fabricators has so far eliminated both the irregularities of manual operation, and the defects attributable to variable operating conditions of fully automatic controls.

Some Discoloration

Good welds in 6A1-4V material usually have a silvery appearance. However, some discoloration adjacent to a weld bead does not denote poor quality if it is less than ⅛ in. wide and is free from flaky white oxide scale.

Due to the stressed condition of parent metal and relative ductility of welds, 6A1-4V pressure vessels must be heat-treated and aged. This is done by mounting each component on an axle-type fixture in a special electric furnace which has accessories to provide an inert atmosphere at elevated temperatures.

During the initial heating cycle, temperatures of 1,500 to 1,700 F are maintained for 30 to 60 minutes.

COMPONENTS for pressure vessels are shown in various stages of fabrication. All are 6A1-4V titanium plate material.

Each vessel is then quenched with a water spray in a uniform manner to prevent warpage during cooling. Aging is accomplished by holding temperatures of 800 to 1,000 F for 4 to 10 hours.

HARDFACING

It's the subject of *Welding Engineer*'s special May issue. Read about alloys . . . about processes . . . about techniques. Here's a wealth of valuable "how-to, when-to" information. Don't miss it!

MATCH PSI FOR PSI

Use P&H Heat-Treatable Electrodes

Now there's a P&H heat-treatable electrode that matches exactly the carbon content of super-strong metals—responds the same way to post heat-treatment. Result: You eliminate many of the machining problems of weld repairs on castings, forgings, etc.

Low-hydrogen iron-powder coatings and special core wires minimize impurities — prevent hot and cold cracking. You get deeper, smoother penetration with less spatter and slag. Electrodes handle easily—are ideal for .25 and .40 carbon, chrome-moly, and 4130, 4140, and 4340 alloys. Get Bulletin R-48. Write to Dept. 313B, Harnischfeger Corp., Milwaukee 46, Wisconsin.

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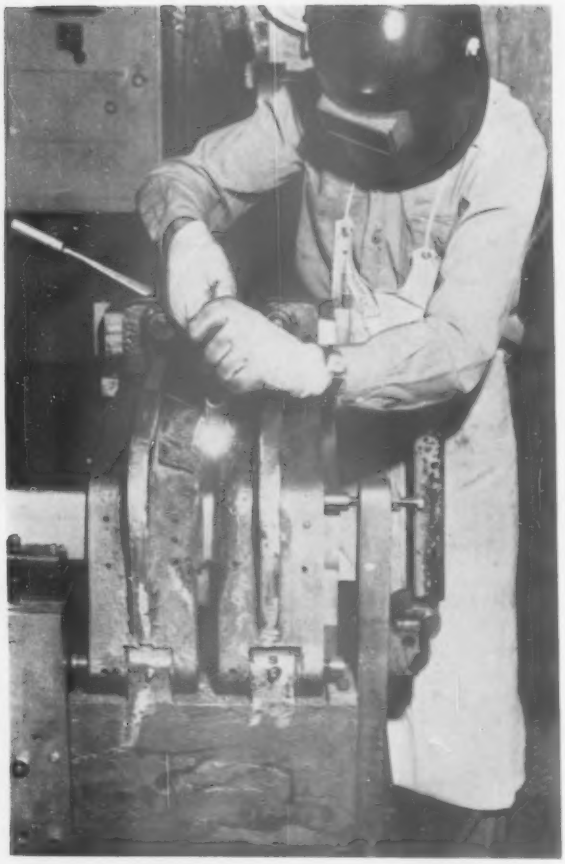
P&H welders • electrodes positioners

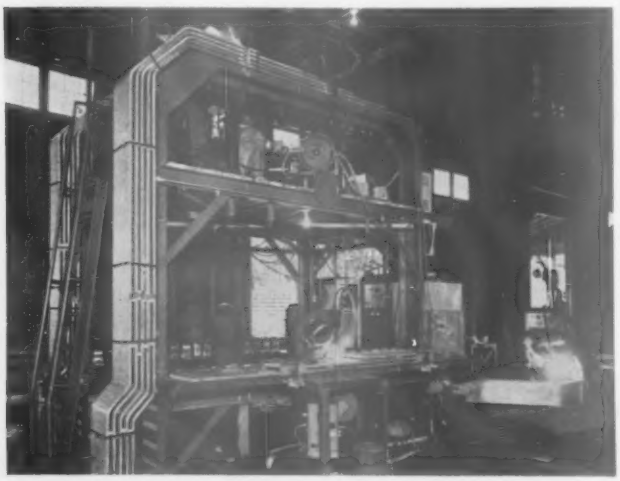


ABOVE: A method of forming large quantities of brazing rings from a spool of silver alloy wire is practiced by Fenwal, Inc., Ashland, Mass. Handy & Harman wire is wound continuously around a mandrel slightly smaller than desired ring OD. When coil is removed from mandrel it is made into individual rings by clipping up the side. Several hundred units can be made in less than ten minutes.

LEFT: Fabricating split doors for combination freezers and refrigerators proved a problem for Ranney Refrigerator Co., Greenville, Mich., until they tried Tig welding. Steps now include drawing a complete door, splitting it in two and, using Linde Co. equipment, Tig welding separate end sections to form two complete split doors.

On the Job . . .

ALUMINUM is being welded on a bi-level jig developed by the Tide Co., Louisville, Ky. For some time, a major portion of company output has been 120,000-amp aluminum bus bars used in high-current electric furnaces. Tide recently expanded its facilities to handle fabrication of ¼-in. and heavier gage stock.



WELDED drums are paving the way for large scrap savings at Boeing Airplane Co., Seattle. The mobile racks illustrated are formed from surplus 55-gallon drums, cut in half, edges rolled, and welded to steel pipe columns.

A. O. Smith o
make sure

a-c WELDERS manual

Featuring abundant use of the finest materials . . . clean design . . . scores of bonus features. Built with bonus factors to last for years of "rugged duty" applications.

Model A18U—180-amp, limited input Utility Welder handles all a-c electrodes 1/16" through 5/32". Welding amps range — 25-180. Has optional battery charger.

Model A180U — 180-amp, limited input Weld and Charge machine. Welds all a-c electrodes 1/16" through 5/32" . . . has full-time battery charger for both six and 12-volt batteries.

d-c WELDERS manual

In addition to the models shown, A. O. Smith can build "standard" rectifiers up to and above 10,000-amp ratings. These machines give you *all* the arc characteristics of m-g sets, eliminate all disadvantages.

Model A2000 — 200-amp d-c rectifier with 80 open circuit volts, range 25-345 amps.

Model A3
with 80 op
amps.

a-c AUTOMATICS

Five basic models feature bonus

fers the inc
you get the ri

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through
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tteries.

Model A20S — limited input Shop Welder — rated at 200 amps, 50% duty cycle . . . 295 amps, 20% duty cycle. 30-310 amps welding range and 80 open circuit volts.

Model A200E — 200-amp Challenger Series standard production welder with amperage range from 30 to 350 and 75 open circuit volts.

Model A300E — 300-amp Challenger Series standard production welder with amperage range from 60 to 430, 75 open circuit volts.

Mod
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75 to

del A3000 — 300-amp d-c rectifier
80 open circuit volts, range 45-500
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Model A4000 — 400-amp d-c rectifier with 80 open circuit volts, range 55-650 amps.

Model A6000 — 600-amp d-c rectifier with 80 open circuit volts, range 120-720 amps.

ustry's most c
right machine

Model A400E — 400-amp Challenger Series standard production welder with amperage range from 75 to 585 and 75 open circuit volts.

Model A500E — 500-amp Challenger Series standard production welder with amperage range from 85 to 680 and 75 open circuit volts.

Model A650E — 650-amp "Auto-Man" production welder with 80 open circuit volts. Rated 500 amps at 100% duty cycle. Welding amps range — 200-720.

Model A8000 — 800-amp d-c rectifier welder-power source with 80 open circuit volts, range 200-1050 amps.

d-c CONVERTORS

250, 350 and 450-amp units convert any a-c welder into a d-c rectifier. Full 60% duty cycle. No separate power-line connection required. They're compact, easily portable, simple to set up and safe.

d-c AUTOMATICS

complete line, e for your job

Model A300HD — 300-amp **extra-heavy-duty** production welder with 75 open circuit volts. Welding amps range — 60-430.

Model A400HD — 400-amp **extra-heavy-duty** production welder with 75 open circuit volts. Welding amps range — 80-530.

Model A500HD — 500-amp **extra-heavy-duty** production welder with 75 open circuit volts. Welding amps range — 100-625.

Model A2500C — 250 amps. Converts any manufacturer's a-c machine to d-c — d-c amp output to 250 amperes.

Model A3500C — 350 amps. Converts any manufacturer's a-c machine to d-c — d-c amp output to 350 amperes.

Model A4500C — 450 amps. Converts any manufacturer's a-c machine to d-c — d-c amp output to 450 amperes.

AUTOMATICS

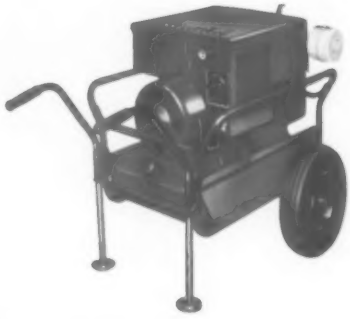
Five basic models feature bonus open circuit volts among many other advantages. Units also offer a substantial bonus in low-cost, long life — regardless of the toughest production schedules.

Model A400HD-B — 400-amp **extra-heavy-duty** power source for automatic welding. Heavy-duty in every respect. 75 open circuit volts. Range, 80-530 amps.

Model A500HD-B — 500-amp **heavy-duty** machine with 75 o cuit volts. Built to keep producing other machines fail. Range, amps.

d-c GAS DRIVES

air and liquid-cooled featuring optional electric start, meters, dual arc reactors. Simplified controls to speed the job. Extreme arc stability. Longer unit life and reduced operating costs.



Model A200A air-cooled, 200-amp d-c welder—"THE BUG," wheel or skid-mounted, weighs only 400 lbs. . . . handles all electrodes from 1/16" to 3/16" straight or reverse. Has auxiliary a-c power source.

Model A2000 gas engine drive mounting, 40 t with or without

ac-dc INERT ARC

Here's truly dependable power for a-c or d-c inert arc welding offering handy, easy setting and control. All models are high-frequency units with gas, water and spot gun controls as accessory equipment. See back page for complete details.

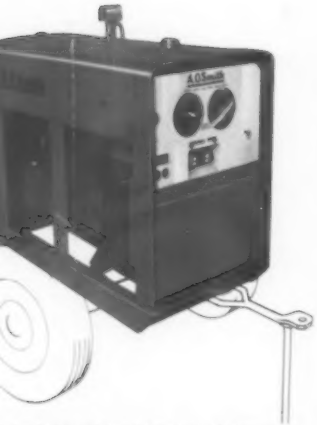
Model A2000AD — 200 amp ac-dc inert arc welder with a-c range from 7 to 275 amps . . . d-c range from 7 to 200 amps. Has auxiliary d-c power source — output is 2 kw, 80 volts.

00-amp extra-
ith 75 open cir-
roducing where
ange, 100-625

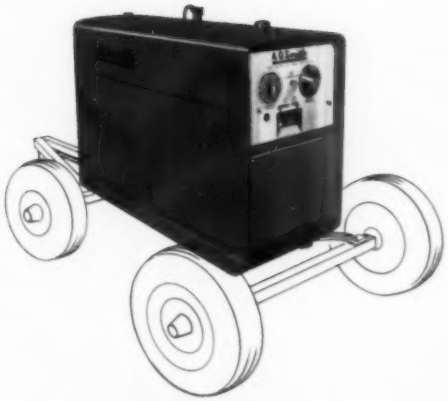
Model A650E-A—650-amp heavy-duty machine that can be used for either manual or automatic jobs. Can be paralleled. Range, 200-720 amps.

Model A1000E-A — 1000-amp heavy-duty machine is available with either 80 or 100 open circuit volts. Range, 250-1250 amps.

Model A1500E-A — 1500-amp heavy-duty machine is available with either 80 or 100 open circuit volts. Range, 375-1875 amps.



A2000W-G liquid-cooled, 200-amp
gine driven welder with skid or wheel
ng, 40 to 250-amp range. Available
r without electric starter.



Model A3000W-GS liquid-cooled, 300-amp gas engine driven welder with choice of mountings, has a 60- to 375-amp range. Electric starter.

Model A4000W-GS liquid-cooled, 400-amp gas engine driven welder offers choice of mountings — 80- to 500-amp work range. Electric starter.

Model A3000AD — 300 amp ac-dc inert arc welder with a-c range from 10 to 395 amps . . . d-c range from 7 to 300 amps. Has auxiliary d-c power source — output is 2 kw, 80 volts.

Model A5000AD — 500 amp ac-dc inert arc welder with a-c range from 15 to 675 amps . . . d-c range from 12 to 500 amps. Has auxiliary d-c power source — output is 2 kw, 80 volts.

a-c AUTOMATICS

Five basic models feature bonus open circuit volts among many other advantages. Units also offer a substantial bonus in low-cost, long life — regardless of the toughest production schedules.

Model A4000-B — 400-amp unit with arc booster to provide 4 distinct arc characteristics. 80 open circuit volts, range, 55-650 amps.

Model A6000-B—600-amp rectifier. 80 open circuit volts, range 120-720 amps. Includes primary line contactor.

CONSTANT POTENTIALS

These three units provide a way to greatly simplify the operators' jobs . . . avoid chances of improper settings or untimely work stoppages for constant adjustment. More details can be found on pages 2 and 3.

Model A6000CP-B — for use with *all* gas shielded and submerged arc automatic and semi-automatic processes. 600 amps.

Model
tential
Will ha

GUARANTEE — All A. O. Smith Welding Machines are guaranteed to provide for free replacement of any part that fails due to defective workmanship or material within one year from date of purchase.

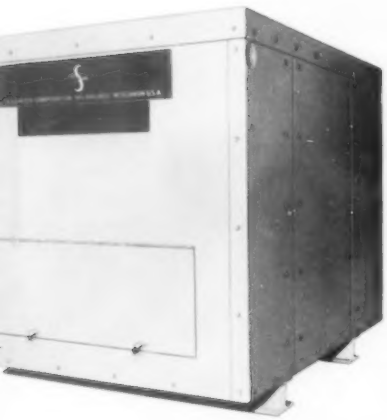
BEFORE YOU BUY ANY WELDING MACHINE . . . . investigate this line in detail. You'll see why you buy better when you buy A. O. Smith job-matched power. Choose from the broad line of 36 models.

80
ps.

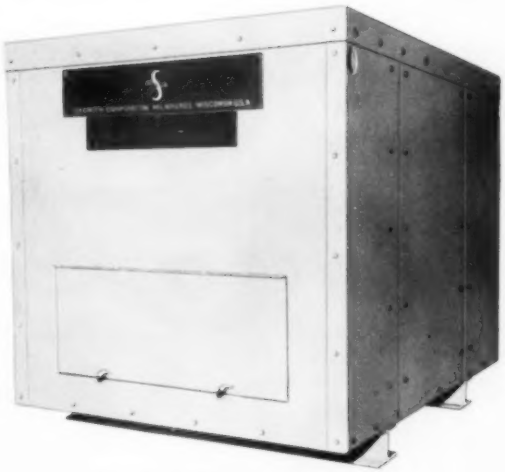
Model A8000-B — 800-amp welder-power source. 80 open circuit volts, range 200-1050 amps. Includes primary line contactor.

Model A10,000-A—1000-amp welder-power source. 80 open circuit volts, range 200-1200 amps. Includes primary line contactor.

Model A12,500-A — 1250-amp power source, range 250 to 1500-amps. Includes primary line contactor.



Model A7500CP — 750-amp constant potential unit for multiple welder operations. Will handle up to 20 welders.



Model A15,000CP — 1500-amp constant potential multiple arc unit for handling as many as 40 welders.

Through research A.O. Smith way *. . . a better way*

A.O.Smith

CORPORATION

WELDING PRODUCTS DIVISION

Milwaukee 1, Wisconsin

A. O. Smith International S. A., Milwaukee 1, Wis., U. S. A.

with "push-button" efficiency

A. O. Smith automatic production lines

five a-c automatics

Model A400HD-B — 400 amps. **extra-heavy-duty,** 75 open circuit volts, 80-530 amp welding range.

Model A500HD-B — 500 amps. **extra-heavy-duty,** 75 open circuit volts, 100-625 amps welding range.

Mode Man," amps

Five basic models — 400, 500, 650, 1000 and 1500 amps — feature primary line contactors as standard equipment. All are available with

d-c automatics — 5 standard models covering the 400- to 1250-amp range. All feature 80 open circuit volts for more precise arc control, regardless of the type of work. Like all A. O.

an "elite corps" of five d-c

man the nation's top

Model A650E-A—650 amps, "Auto-Man," 80 open circuit volts, 200-720 amps welding range.

Model A1000E-A—1000 amps, 80 or 100 open circuit volts, 250-1250 amps welding range.

Model A1500E-A—1500 amps, 80 or 100 open circuit volts, 375-1875 amps welding range.

or without automatic remote current control. All can be paralleled with like models for higher amperage requirements.

Smith welding machines, they're quality-built in every detail . . . easy to set up, regulate and work with. Primary line contactor is standard. Automatic remote current control is optional.

ATTACK

the rising costs of welding production

Air or liquid-cooled gas engine driven welders

Inert arc machines

a-c and d-c machines — manual and automatic models

limited input machines

Whatever type of welding machines your work requires, you'll find the right ones in the A. O. Smith line-up—to make actual work easier . . . provide added productive flexibility . . . give you years of bonus service life. A. O. SMITH CORPORATION, MILWAUKEE 1, WISCONSIN.

Here's the newest, most versatile power source ever offered. Using standard resistance grids, many customers report up to 40 welders working from *one* power source.

troublesome motor generators as well as tot- tion applications, these CP units offer all the advan- tages of m-g sets with none of the maintenance cost disadvantages. Particularly adaptable to construction, ship-building and similar industries.

plus

3 of the very latest inert arc a-c, d-c and ac-dc models

Designed to provide new high standards of operating efficiency, these machines offer a wide range of working amperages, precision-set at the mere twist of a dial — even while the machine is in operation. "Hi-Fi" frequency control speeds striking, stabilizes arc regardless of whether machine is operating in middle or extreme ranges.

All three models are available with or without gas and water controls and remote control that's effective as far as 50 feet away. They can be set up for — metallic arc a-c or d-c, straight or reverse... Heliarc® a-c or d-c, straight or reverse . . . Auto Heliarc® a-c or d-c . . . sigma . . . or spot welding, a-c or d-c.

and there's more on the way!

Because A. O. Smith is one of the world's largest single users of welding in its own production — its research and development efforts are far more intensive than those of the ordinary welding equipment producer.

Today, A. O. Smith is readying a host of additional equipment that will further help you take the offense against welding costs with new equipment, new techniques, new means to weld previously tough metals.

Through research . . . a better way

A.O.Smith
CORPORATION
WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin

A. O. Smith International S. A., Milwaukee 1, Wisconsin, U. S. A.
Bulletin No. MW-216—65M Printed in U. S. A. 3-1-58

d-C automatics

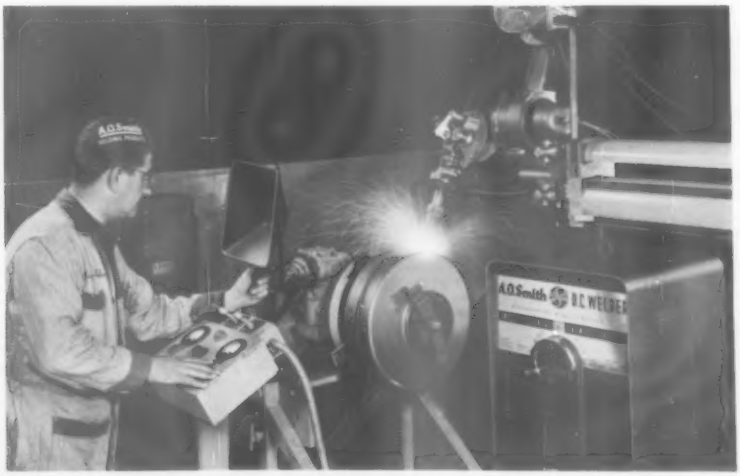
Model A4000-B — 400 amps at 60% duty cycle, 55-650 amps welding range.

Model A6000-B — 600 amps at 60% duty cycle, 120-720 amps welding range.

and two revolutionary means to attack automatic and semi-automatic jobs

C-OMATIC

—a high-speed, CO_2-shielded, automatic process that's easy to set up, easy to use. Complete package includes control console, remote control stand, automatic head and an A. O. Smith 600-amp power source.



C-OMATIC includes an automatic head, portable control console and remote control console plus power source.

ps at
weld-

Model A8000-A — 800 amps at 100% duty cycle, 200-1050 amps welding range. Includes primary line contactor.

Model A10,000-A—1000 amps at 100% duty cycle, 200-1200 amps welding range. Includes primary line contactor.

Model A12,500-A—1250 amps at 100% duty cycle, 240-1500 amps welding range. Includes primary line contactor.

C-OMANUAL includes Low-Boy CP power source and portable (in this case it's placed on top of the power source) control console and hand gun.

C-OMANUAL

—a CO_2-shielded hand-gun process that puts manual welding on a mass production basis. Includes lightweight, self-cooling hand gun which needs no adjustment for arc distance, compact, easily portable control console and the new 600-amp Constant Potential Low-Boy. Utilizing the economy of carbon dioxide as a shielding gas and new lower cost wires developed by A. O. Smith's laboratories the C-OMANUAL process reduces welding costs by more than 50%.

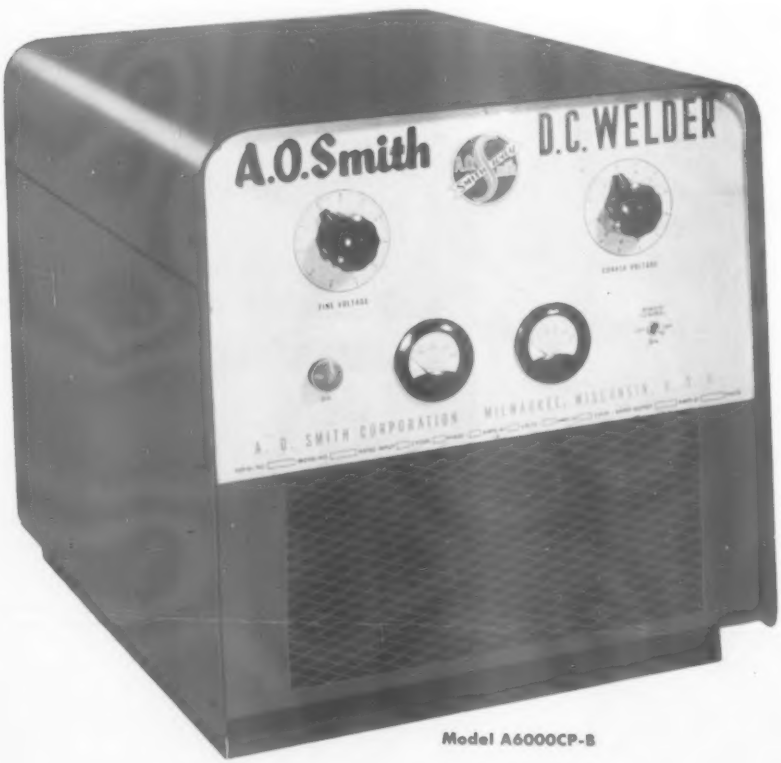
HANDGUN is light in weight, self-cooled and perfectly balanced to minimize operator fatigue.

A.O.Smith d-c const

600 amps for gas-shielded or submerged arc welding

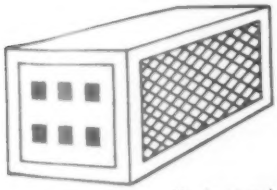
Model A6000CP-B — Here's the newest, most efficient power unit for all gas-shielded and submerged arc automatic or semi-automatic welding. Features 0 to 45.4 voltage range . . . built-in 230/110V power supply and superior voltage regulation. Can be paralleled to provide 1200 or more amperes. Compact, relatively simple in construction, it has a minimum of circuitry.

Further, as opposed to conventional arc welders, it provides constant voltage with *variable* current. Thus, by merely shortening arc length, the operator can *really* lay down metal. He doesn't have to worry or stop for constant adjustments on the machine. His only concern is with the arc length . . . making simple increases in wire feed rates.



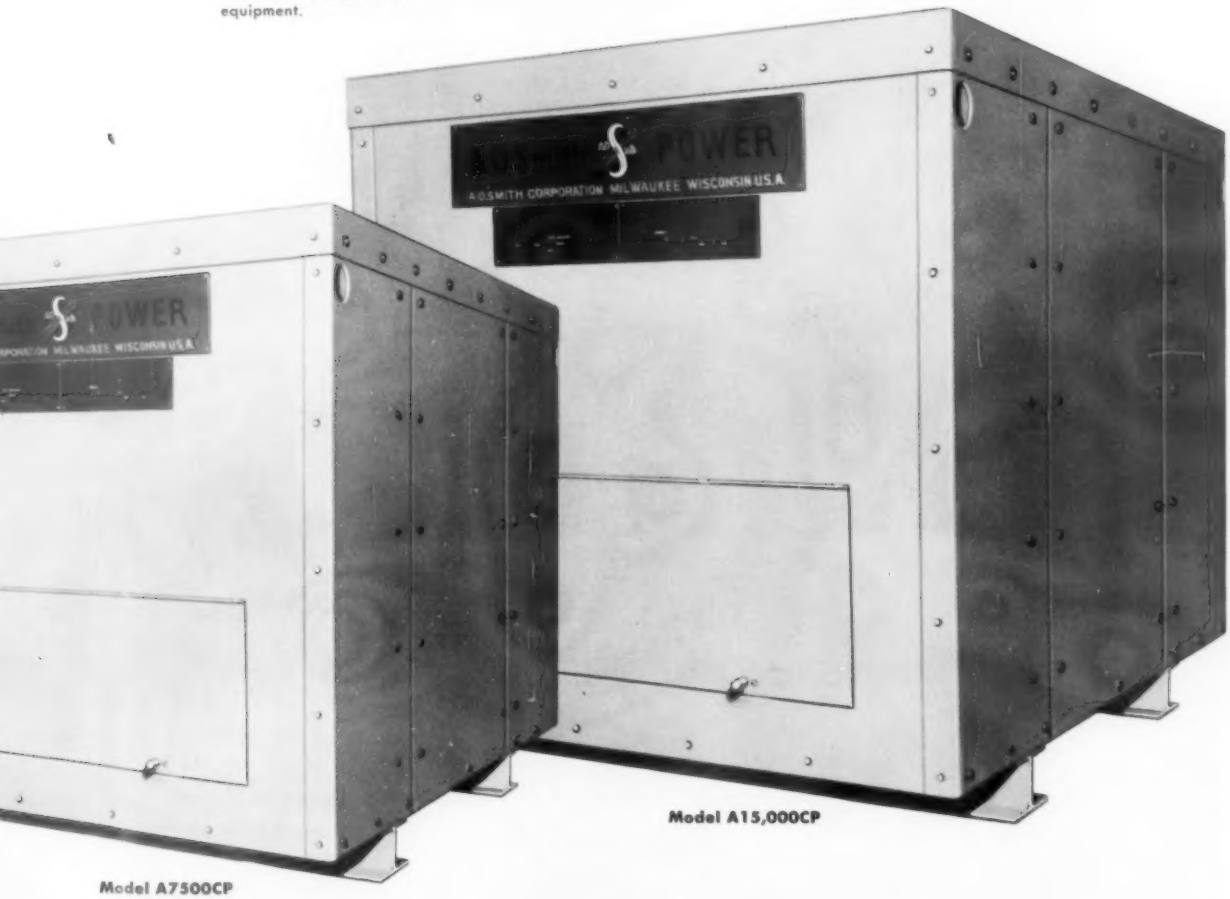
Model A6000CP-B

stant potential machines



Single or multiple operator resistance grids are available as standard equipment.

750 or 1500 amps for multiple operator manual welding



Model A15,000CP

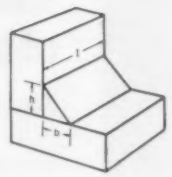
Model A7500CP

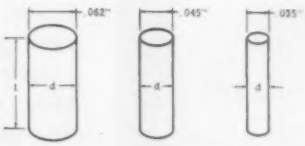
20 to 40 operators from one power source! Here's the newest, most versatile power source ever offered. Using standard resistance grids, many customers report up to 40 welders working from *one* power source.

Designed to augment or replace cumbersome, troublesome motor generators as well as for new applications, these CP units offer all the advantages of m-g sets with none of the maintenance cost disadvantages. Particularly adaptable to construction, ship-building and similar industries.

TABLE illustrating wire diameter, wire feed speed, and diagram of welded fillet. Note base, height, and length abbreviations.

WIRE DIAMETER	.035"	.045"	.062"
WIRE FEED RANGE	600-900	400-600	200-400





Complicated math is out with a—

Slide rule for automatic welding

By A. J. Rosenberg,
Metals Engineering
General Electric Co.
Lynn, Mass.

ONE FREQUENT TASK many of us are called upon to perform is "establishing the variables" in order to produce a weld of a given size or configuration.

In manual techniques, there are general rules for obtaining optimum settings of current, arc length, etc. But in automatic operations, evolution of satisfactory procedures has been a somewhat hit or miss proposition.

In a recent development at GE's aircraft accessory turbine dept., it was realized that optimum ranges of current, wire size, and voltages did, in fact, exist for automatic welding. And, further, that its repetitious nature made it possible to predict weld settings in terms of wire size and feed, travel speed, and weld dimensions.

While examples discussed here are for Mig (metal inert-gas), principles involved are directly applicable to any mechanized operation in which bare wire is automatically fed to the joint.

However, optimum range of current or wire feed speed necessary for any given wire size must be established experimentally before trying to predict weld settings.

This is best done by actually welding with different diameter welding wires and varying the wire feed speed over a wide range. Observation of arcing characteristics and bead contours reveal ranges most suitable for welding.

In the case of G-E's Mig equipment, it was found that 0.035 in. diameter stainless steel wire performed satisfactorily at wire feed speeds from 600 to 900 ipm. It was also learned that 0.045 and 0.062 in. diameter wire operated properly at feeds of 400-600 ipm and 200-400 ipm.

Armed with these facts, it was a simple matter to establish a setting.

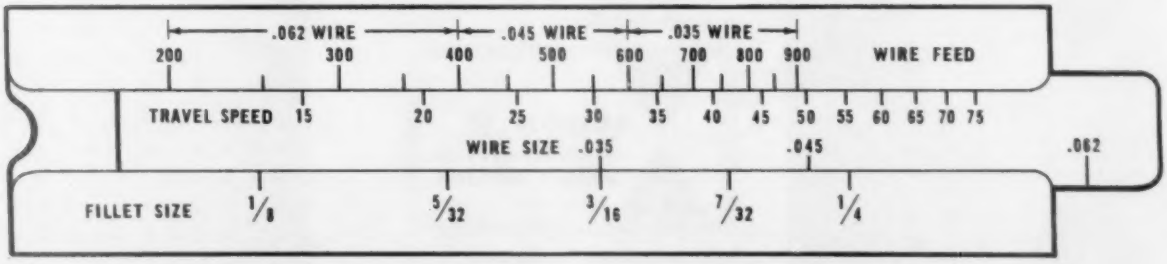
The initial decision to be made before welding the fillet between a flange and cone section was that of the fillet size itself. Once this had been made on the basis of design practice, weld setting problems became purely mathematical.

Fillet Size

For example, let us assume we want a 3/16 in. fillet. Volume of metal needed to produce such a weld is ½ bhl (basexheightxlength), or 0.0176 cu.in.per in. of length. If we were to select 0.062 in. diameter to make this weld, it would have a volume of $(\pi d_2/4)$ 1, or 0.00301 cu in. per in. of length.

Thus, at 400 ipm (high point of the wire feed speed range) we would deposit 400x0.00301=1.204 cu in. of metal per minute. This could produce: 1.204÷0.0176=68.4 in. of weld in one minute of the fillet.

Of course, in order to do this,



SLIDE rule discussed in article. Cut from page to serve as your own rule, or construct one with this as a model.

F-101 Supersonic Fighter built by McDonnell Aircraft Co., St. Louis, Missouri.

Aluminum dip brazing solves fabrication problem for fighter oil-cooling unit

The plate-type lube oil cooler of the F-101 supersonic fighter must cool the lifeblood of its engine dependably and efficiently in rarified atmospheres. Its design, consisting of a complex perforated grid enclosed in a crimped sheet envelope, demands strength to withstand 400 psi internal oil pressure. *Thousands of tiny grid surfaces had to be joined firmly to the plate envelope with the strength of a single unit.*

A joining problem such as this could only be solved by the aluminum dip-brazing technique. In this instance, Alcoa No. 6061 alloy was joined with Alcoa No. 22 brazing sheet by dipping in molten flux. Result, an all-aluminum unit of high corrosion resistance with strong and uniformly smooth joints.

Aluminum brazing offers many design approaches and advantages worth considering in the planning stage. Complicated assemblies with inaccessible joints can be made as a single unit which is smaller, lighter, more efficient *and* lower in cost. Close tolerances in small parts are obtainable—joints may be built up to desired strength.

Get in touch with Alcoa *before* you plan. We'll supply the information you need for welding, brazing or soldering aluminum. Contact one of the Alcoa distributors listed at the right or send for free information books and films on joining aluminum. Write to Aluminum Company of America, 1740-D Alcoa Building, Pittsburgh 19, Pennsylvania.

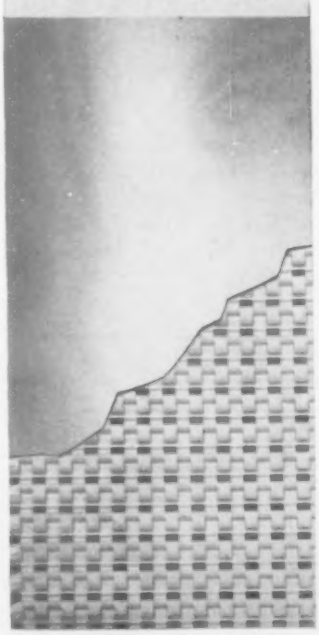
Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM WELDING PRODUCTS
ALUMINUM COMPANY OF AMERICA

"ALCOA THEATRE"
Exciting Adventure, Alternate Monday Evenings

Plate-type aircraft lube oil cooler made by Clifford Manufacturing Co., Waltham, Mass., a division of Standard Thomson Corporation. Vertical plates and V-shape dividers or fins provide a heat transfer service of 32½ sq. ft. Oil is cooled by passage of air through these plates.

Cutaway of plate and interior grid through which oil flows.



Want technical help in welding, brazing or soldering aluminum? Contact your Alcoa sales office, listed under "Aluminum" in the Yellow Pages of your phone book.

For immediate delivery of Alcoa welding products, call your Alcoa outlet listed below. He carries a complete range of alloys and sizes.

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Hinkle Supply Co.

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Whitehead Metal Products Co., Inc.

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The J. M. Tull Metal & Supply Co., Inc.
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Steel Sales Corp.
Moline
Machinery & Welder Corp.

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WEST VIRGINIA
Bluefield
Southern Oxygen Co.

WISCONSIN
Milwaukee
Machinery & Welder Corp.
Steel Sales Corp.

travel speed would be 70 ipm.

Similarly, for 0.045 in. wire, the wire feed speed might be selected as 600 ipm; volume of wire would be 600x0.00159=0.954 and travel speed would be calculated by dividing volume of metal supplied by volume of metal required, or approximately 54 ipm.

For 0.035 in. diameter wire, the calculations show that for 900 ipm of wire feed speed, 48 ipm of 3/16 in. fillet can be produced. This latter setting, incidentally, was the one we chose.

Simplified Calculations

It is rather burdensome to go through such calculations for each setting. It is much more practical to record these values in a way that they are available in terms of welding variables themselves.

All mathematics presented thus far have been simple multiplication or division, and a convenient way of presenting this data is on a slide rule. It is a simple task to construct such an instrument.

What variables are involved? First, volume of metal desired. Second, volume of metal available (wire size). Finally, travel speed needed to yield desired volume when wire feed speed is within the optimum range.

This can be expressed as follows $V_w F = {}_k V_f T$. Definition of these symbols is:

V_w=volume of wire in one in.
F=wire feed in ipm.
V_f=volume of fillet in one in.
T=travel speed in ipm.
${}_k$=deposition efficiency factor.

Slide Rule Figures

This simple calculation can be done rapidly on a slide rule; especially if Volume values appear in terms of fillet size and wire diameter.

In other words, the volume of a 3/16 in. fillet is actually 0.0176 cu in. per in. of length. The point corresponding to this on the slide rule can be termed: 3/16 in. fillet.

If all extraneous values are removed, the complete rule illustrated in this article can be constructed. To operate the rule, wire diameter is set above desired weld size; then travel speed required for optimum wire feed speed is readily apparent.

This kind of rule can be successfully applied to find settings for butt welds, grooves, etc., so long as volume of metal is considered.

9 ways better

Picker GARDRAY radiation badges

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wide intensity range
Records exposures low as 50 mr, high as 300,000 mr.
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Gamma, beta, x-rays (soft and hard) single or mixed exposures.
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Separate control badge guards against accidental fogging.

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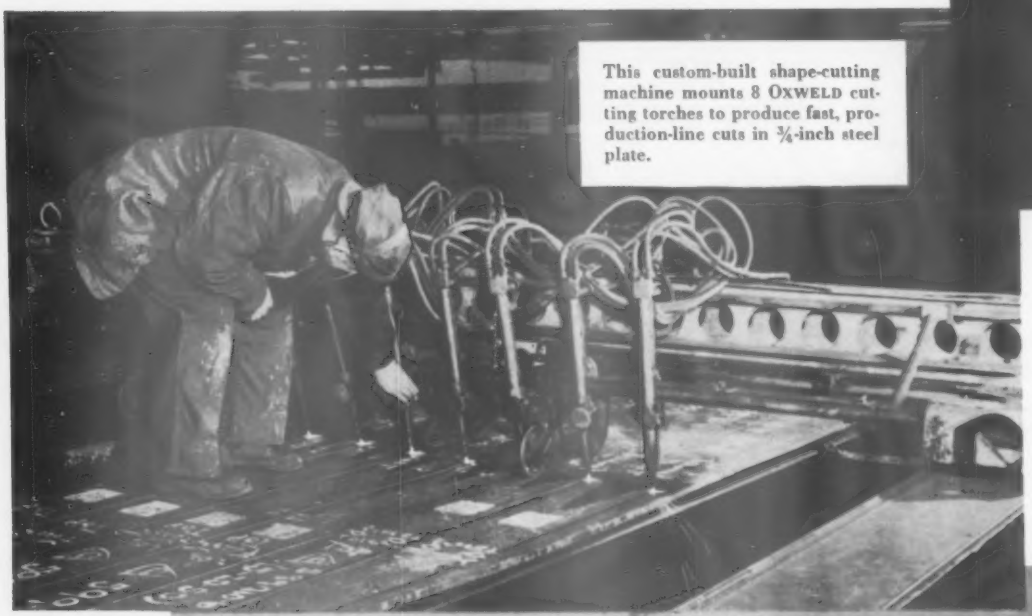
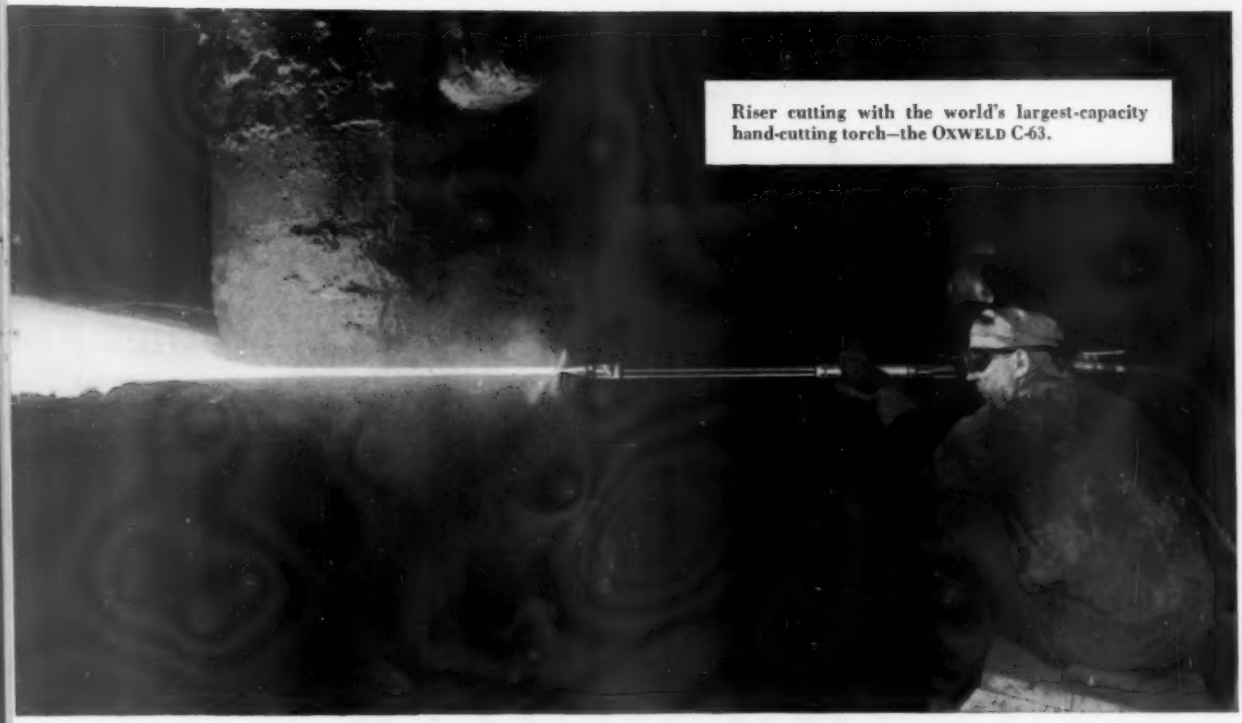


This custom-built shape-cutting machine mounts 8 OXWELD cutting torches to produce fast, production-line cuts in ¾-inch steel plate.

A full selection of precision-made OXWELD nozzles assures maximum usefulness for every cutting torch.



Riser cutting with the world's largest-capacity hand-cutting torch—the OXWELD C-63.

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Hand-cutting, shape-cutting, scarfing, powder-cutting . . . you name the cutting job! And pick the fuel gas combination, too . . . oxy-acetylene, oxy-propane, oxy-natural gas. Whatever your flame-cutting requirements, there's a complete line of dependable OXWELD torches to meet them exactly.

You can choose from the widest selection of top quality torches and nozzles ever made available—a choice that assures you of genuine OXWELD performance on every cutting job. Backed by half a century of know-how, OXWELD cutting torches and OXWELD nozzles are designed and built to give you trouble-free service, one hot job after another, year in year out.

Ask your nearby LINDE representative to *prove* OXWELD performance to you today. He'll be glad to study your flame-cutting program and demonstrate how OXWELD cutting torches can help you save. Also write for free booklet, F-1174. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

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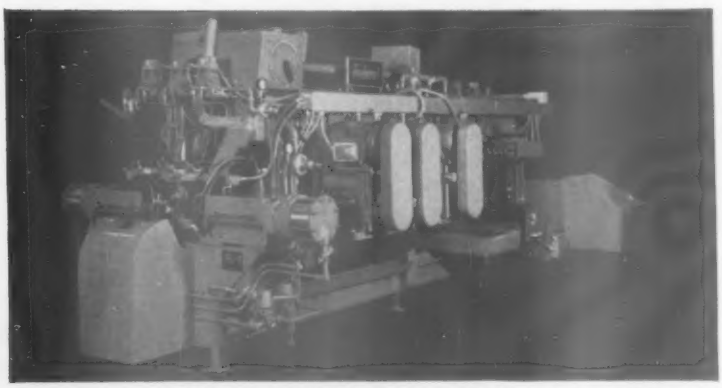
one-source production lines spark interest of volume producers...

The prospect of ordering an entire production line, ready made to produce a part to specification, has arrested the interest of many of the nation's top production engineers.

One source responsibility assuring better service; a line 100% harmonic, all stations engineered to work in perfect synchronization; integrated and automated handling of work in process; utilization of common drives and bases, reducing operating costs and floor area, are some of the advantages of the packaged line that has production people talking.

Federal/Warco pioneered the packaged line and have already produced automated lines combining such operations as blanking, forming, drawing, welding, machining, drilling, assembling on a common base.

For additional information contact the Federal/Warco representative nearest you or write direct.



This Federal Packaged Production line welds, spot faces, reams, de-burrs, sets six bolts and welds them in place . . . ejecting finished pedal brackets at a rate of 775 pieces per hour.

Federal / Warco
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PRODUCTION LINES

THE FEDERAL MACHINE AND WELDER COMPANY - WARREN, OHIO

422 AFFILIATED WITH BERKELEY-DAVIS, INC., DANVILLE, ILLINOIS, MANUFACTURERS OF AUTOMATIC ARC WELDING EQUIPMENT.

Melting points of reactor materials

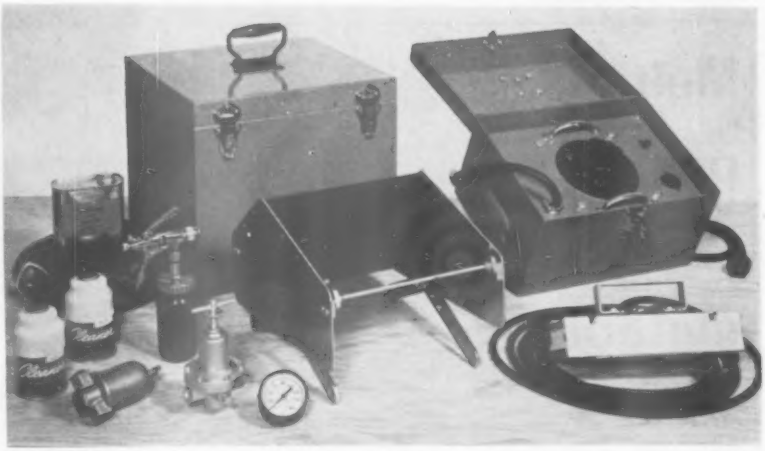
LISTED BELOW are melting points of known materials which might be suitable for reactor use. A design team at Nuclear Development Corp. of America compiled the list as part of a materials and design study for high-temperature reactors for the Atomic Energy Commission. Leon Davidson and Alfred A. Strasser included it in a paper presented before a recent meeting of the American Institute of Chemical Engineers. NDA notes that "no consideration was given to fabrication qualities".

Material	Melting point (F)
Niobium carbide (NbC)	6800
Graphite (C)	6700
Zirconium carbide (ZrC)	6400
Titanium nitride (TiN)	5800
Barium Phosphide (Ba_3P_2)	5790
Titanium carbide (TiC)	5700
Zirconium nitride (ZrN)	5400
Vanadium carbide (VC)	5090
Strontium zirconate (SrO ZrO_2)	5070
Magnesium oxide (MgO)	5070
Zirconium oxide (ZrO_2)	4900
Molybdenum (Mo)	4760
Barium zirconate (BaO ZrO_2)	4748
Cerium oxide (CeO_2)	4712
Calcium oxide (CaO)	4660
Molybdenum carbide (Mo_2C)	4650
Zircon ($ZrSiO_4$)	4622
Beryllium oxide (BeO)	4568
Cerium sulphide (CeS)	4440
Strontium oxide (SrO)	4406
Silicon oxide (SiO)	4406
Yttrium oxide (Y_2O_3)	4380
Niobium (Nb)	4380
Vanadium nitride (VN)	4280
Calcium zirconate (CaO ZrO_2)	4230
Chromium oxide (Cr_2O_3)	4127
Zirconium silicides (Zr_3Si_2, Zr_4Si_3, Zr_6Si_5)	4010-80
Aluminum nitride (AlN)	4060
Silicon carbide (SiC)	4000
Barium sulphide (BaS)	4000
Beryllium nitride (Be_3N_4)	4000
Barium nitride (Ba_3N_2)	3990
Chromium aluminide (CrAl)	3920
Molybdenum aluminide (Mo_5Al)	3900
Spinel ($MgAl_2O_4$)	3874
Titanium dioxide (TiO_2)	3866
Calcium silicate (2CaO SiO_2)	3866
Titanium silicide (Ti_5Si_3)	3848
Beryllium carbide (Be_2C)	3812
Calcium chromate ($^{\infty}$CaO Cr_2O_3)	3812
Aluminum oxide (Al_2O_3)	3722
Niobium nitride (NbN)	3722
Molybdenum disilicide ($MoSi_2$)	3686
Nickel oxide—aluminum oxide (NiO Al_2O_3)	3668
Beryllium silicate (2BeO, SiO_2)	3630
Barium oxide—aluminum oxide (BaO Al_2O_3)	3630
Magnesium sulphide—strontium sulphide (MgS, SrS	3600
Nickel oxide (NiO)	3560
Niob .m disilicide ($NbSi_2$)	3542
Barium oxide (BaO)	3490
Beryllium oxide—aluminum oxide (BeO Al_2O_3)	3470
Silicon-nitride (Si_3N_4)	3452
Chromium carbide (Cr_3C_2)	3440
Chromium (Cr)	3430
Zirconium (Zr)	3350
Molybdenum beryllide ($MoBe_2$)	3344
Mullite ($3Al_2O_3$ $2SiO_2$)	3290
Zirconium beryllide ($ZrBe_9$)	3180
Vanadium (V)	3150
Silicon dioxide (SiO_2)	3110
Zirconium disilicide ($ZrSi_2$)	3092
Vanadium disilicide (VSi_2)	3020-3180
Molybdenum aluminide (MoAl)	3090
Titanium (Ti)	3074
Nickel aluminide (NiAl)	3000
Zirconium aluminide ($ZrAl_2$)	3000

On this and on pages 100, 102, 104, 106, and 108 WELDING ENGINEER *presents a preview of five important new products and processes which you first read about on our "Weld-World" page.*

Of the five products described here, only those announced by Lincoln, Airco, and A. O. Smith will be on display at the AWS Welding Show in St. Louis this month (April 15-17). Magnaflux Corp.'s "Bondcheck" system (see article at right) will not be exhibited.

Still another new process to be shown in St. Louis will be described in more detail next month. This is Bernard Welding Equipment Co.'s "LC" welding system, which is said to deposit conventional stick electrodes at speeds higher than semiautomatic methods. Key to the process is a water-cooled electrode holder and recirculating system.



TWO cases contain all necessary material for use of new Magnaflux test method. "Powerstat" unit is in case at right.

New test for honeycombs

FOR THE location of poor-bond—or no-bond — areas in metal honeycomb structures, Magnaflux Corp. of Chicago has introduced a new testing system called "Bondcheck".

Sold as a "BC-1 inspection kit", the method is "most successfully used on honeycomb which has been soldered, welded or brazed to skin surfaces," the company reports. Low kit cost is stressed in the introductory announcement by Magnaflux.

Procedures

Here are the important steps in the "Bondcheck" test procedure:

1—Clean the part surface.

2—Spray on the specially-formulated red fluid.

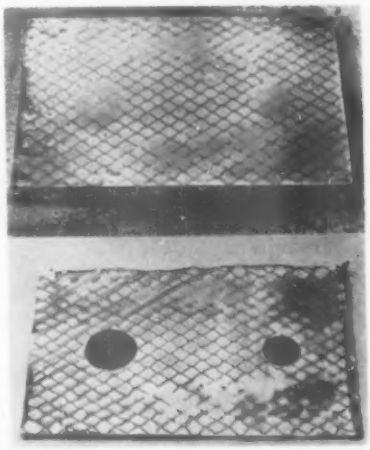
3—Apply controlled heat from a high-intensity infra-red lamp.

Heat applied to the surface is conducted into the core wherever good bond exists between core and surface. The "Bondcheck" fluid is repelled by heat and tends to flow to the coolest areas on the surface.

So wherever bond defects exist, they will be visible as a gap in the pattern of fluid dispersal.

Automatic Test

Magnaflux states that deformed core materials are also readily apparent when its new test method is used. The inner core pattern is visible in the outer surface pattern.



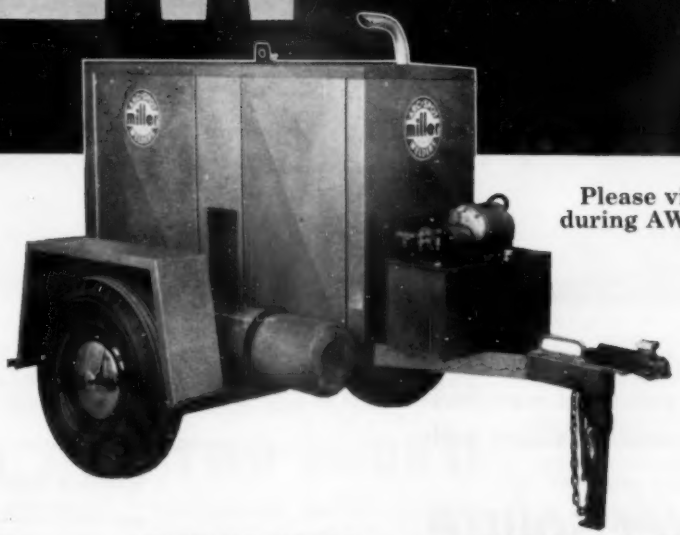
ACCURACY of system is indicated when gaps in fluid dispersal *(top photo)* are verified by removal of outer skin *(bottom photo)* to show defective core.

The firm reports also that the test takes only a few seconds per area tested, and that any complex shape can be tested. Automatic testing, says Magnaflux, is practical on simple shapes.

The new kit consists of two separate carrying cases. In one case is an inspection stand, a spray gun, 25 ft of air hose, an air pressure regulating valve, an air gage and filter, one quart of testing fluid, and two 12-oz cans of cleaning agent.

In the second case is a "powerstat" which enables the inspector to vary heat intensity. This unit operates on 110-volt, 60-cycle, 1-phase current, and draws up to approximately 15 amp.

NEW DESIGN POWER PERFORMANCE



Please visit booth #507
during AWS welding show

BIG . . . TOUGH . . . RELIABLE

. . . and offered in three models for every "beyond the power line" job:

The ROUSTABOUT D-250 DC for metallic arc welding
The BIG RIG DA-300 AC/DC for metallic arc welding
The FIREBALL DAH-350 AC/DC for metallic arc and tungsten inert gas welding

All models have a 10 kw single phase 115/230 volt ac power plant and deliver, while welding, 1 kw of 115 volt dc auxiliary power. Proven Miller ac generator is driven by Hercules engine. Coupled with the revolutionary new Miller semimetallic rectifier, this produces the industry's finest performing dc welding current . . . bar none!

Complete particulars will be sent promptly. Please indicate model in which you're interested.

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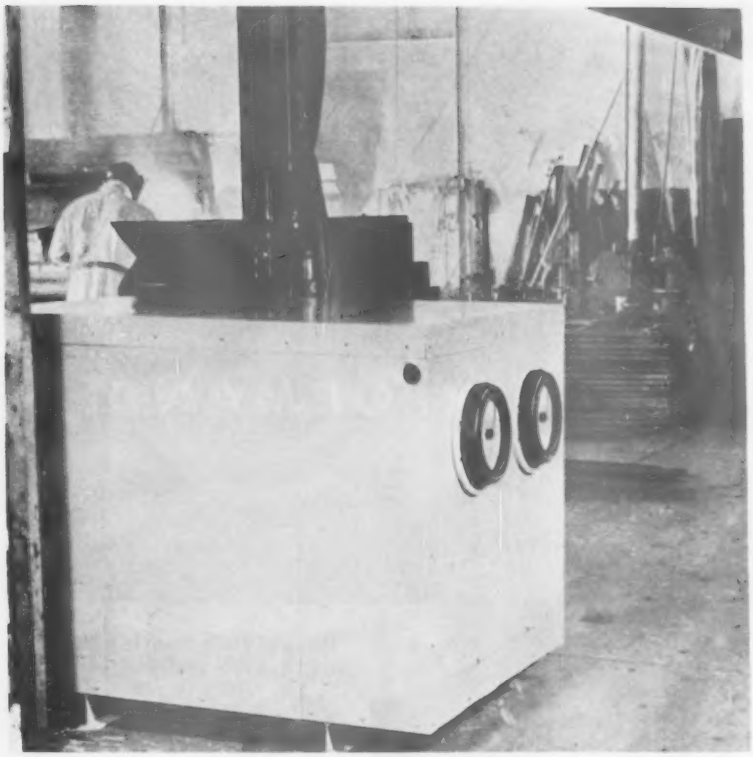
Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal • APPLETON, WISCONSIN



MULTI-arc unit is 42½ in. wide, 56 in. deep and 44 in. high; 16-gage housing is waterproof. Behind door in lower half of front panel are two output bus bars for welding cable connection.

A. O. Smith Corp.'s new 750 and 1,500-amp d-c constant-potential machines with silicon rectifiers provide weldors with . . .

One power source for many arcs

THE FOLLOWING advantages were listed by A. O. Smith Corp. as it announced availabilty of new 750 and 1,500-amp multi-arc d-c constant-potential units. Wherever the machines are applicable, here is what the Milwaukee firm says they will do:

1—Occupy considerably less outside space than a group of single-operator welding sets.

2—Enable a weldor to adjust arc heat from any work position by locating the series grid near the work.

3—Reduce by at least 80% the primary power connection and welding lead problem.

4—Give improved welding characteristics.

5—Reduce maintenance to a minimum with a simple control system.

6—Allow operation of many arcs from a single power unit—or power a number of stud welders.

To justify its claim for the new units, A. O. Smith cites the "Model 15000 CP" 1,500-amp machine and gives these facts as an example of operational capabilities:

Power supply is rated at 1,500 amp continuous duty, with 80-volt open-circuit voltage and 73 to 75-volt full-load output voltage. This unit rating includes provision for short-term overloads which occur occasionally when more than the usual number of weldors strike and run an arc simultaneously.

Electrical Specifications
(1,500-amp unit)

Primary voltage	460 or 600 volts, 3-phase, 60 cycle
Primary kva requirement	134
Efficiency	94%
Power factor	96% lag
Open-circuit voltage	80 volts d-c
Full-load voltage	75.5 volts d-c

(Standard model designed 460 volt with taps at +5%, —5% and —10% of rated line voltage.)

If this occurs—and if the unit has run continuously and reached its maximum operating temperature—it will carry 2,250 amp for two continuous minutes to handle the overload. A circuit breaker will stop current flow if this time limit is exceeded without a reduction in current demands.

If operations are halted in this manner, Smith states that the circuit breaker can be instantly reset and the unit re-started. But users are warned that repeated trippings will necessitate the discontinuation of operations from this power source.

Most grids are rated on a 60% duty cycle. Each weldor controls his output current, and is unaffected by other

Low Temperature EUTECTIC WELDING ALLOYS

Plant, Research Laboratory and World Headquarters

HISTORY OF "EUTECTIC LOW TEMPERATURE WELDING ALLOYS"®

Surface alloying at low heat was first discovered by "Eutectic" in 1904 – used today in over 100,000 plants. "Eutectic" is the originator and sole manufacturer of "Eutectic Low Temperature Welding Alloys" for bonding metals at low heat, minimizing distortion, warping and stress.

EUTECTIC Welding News

PUBLISHED BY EUTECTIC WELDING ALLOYS CORPORATION, 40-40 172 STREET, FLUSHING 58, NEW YORK, N. Y.

CAST ALUMINUM GEAR HOUSING REBUILT IN JUST TWO HOURS!

A severe blow cracked this expensive aluminum gear case. The lengthy crack passed through the ribs of the case as well as the flange. Replacement with a new casting meant considerable expense, but the difficulties of welding aluminum satisfactorily seemed to rule out repair, until the local "Eutectic" Technical Representative was called in and recommended Eutectic's EutecTrode 2101 with "Frigid Arc" flux coating.

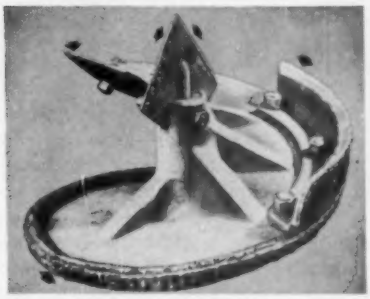
EutecTrode 2101, makes joints which are up to three times the strength obtained with conventional aluminum welding electrodes. Ultimate tensile strength—34,000 psi. Deposits are smooth, dense, non-porous and spatter-free. Arc is quick and easy to maintain. EutecTrode 2101 is non-fuming, has amazing arc stability with high corrosion resistance, good color match to aluminum.

This particular electrode is widely used for the production and maintenance welding of home appliances, chemical, food processing and refrigeration equipment. It is also used for decorative and protective railings, tanks, structural members, pipe, foundry patterns, truck, automotive and bus structures. Other applications include repairing cracks, filling holes, building up missing sections, cladding and reinforcing.

To prepare the gear case for the filling operation the crack was chamfered through its entire length. There was no porosity, no holes throughout the fill and build-up. To finish the job a sander was used to smooth the surface. The completed gear case had the appearance of a new replacement part.

Only two hours were needed to complete the repair of the cast aluminum gear housing, and return it to operation.

EUTECTRODE 680 AC-DC *inaugurates new auger life*



This farm auger was so badly worn it required complete rebuilding. The condition is common in farm tools used in abrasive soil. Because of widely varying soils, blades that give good service in one area can fail completely after a few acres in another. Today, maximum acreage service under all conditions is assured with regular use of EuteChrom overlays.

Best results with hard surfacing are attainable in many cases by first using a padding layer of EutecTrode 680 AC-DC. The padding base offsets any possibility of cracking during the welding operation, and in service, absorbs much of the impact shock. Thus, long life is insured with this hard overlay.

To repair this auger, a new steel strip was welded to the blade rim with patented EutecTrode 680 AC-DC. All wear surfaces were then overlayed with EutecTrode 12 AC-DC. This economical reconstruction gave the auger months more service life than even new equipment could provide.

EutecTrode 680 AC-DC, available in 3/32", 1/8", 5/32" & 3/16" dia. Lt. Blue Tip. • **EutecTrode 2101**, available in 1/8", 5/32", 3/16" & 1/4" dia. Orange Tip. Standard weight shipments.

VISIT OUR BOOTH 505

A W S WELDING SHOW

Sponser: American Welding Society, Inc.

APRIL 15-16-17, '58
KIEL AUDITORIUM
St. Louis, Missouri

EUTECTIC 'LOW TEMPERATURE WELDING ALLOYS'® FORMULATED FOR 'LOW HEAT INPUT' BONDING OF ALL METALS INCREASE SAVINGS BY SALVAGE AND REPAIR, SOLVE PRODUCTION PROBLEMS

arcs operating from the same unit. To calculate the number of grids which may be attached to a single 1,500-amp unit, use this calculation:

1. Determine expected duty cycle for manual welding operation ... 60%
2. Divide rating of unit or units (may be connected in parallel) by duty cycle ... $\frac{1500}{.60}$ = 2500 amp
3. Obtain average expected arc current ... 5/32-in. electrode @ 180 amp
4. Divide current (step 2) by individual arc current ... $\frac{2500}{180}$ = approx. 14 arcs

These calculations are based on optimum conditions of a 60% duty cycle. Given these conditions, fourteen 180-amp arcs *could* be operated from the 1,500-amp unit. And even if all 14 weldors were to strike simultaneous arcs first thing in the morning, the machine reportedly could carry this approximate 2,500-amp load for the time it takes to burn an electrode down.

Not only will the machine handle the above load, says the manufacturer, but it will provide approximately 3,000 amp for one minute and 4,500 amp for 12 to 15 seconds. When 5,000 amp or more are drawn, the circuit breaker automatically—and instantly—takes the unit off the line.

40 for Tacking

A. O. Smith notes that a total connected current load in excess of 3,500 amp will not normally be sustained by the unit without tripping by the circuit breaker. But on some types of jobs—particularly tack welding—as many as 40 grids might be connected. The important thing, Smith says, is that the unit lets the user know when it is over-taxed.

The multi-arc machines may be used, as noted above, for stud welding (with series resistance grids). They may also be employed for high-amperage carbon-arc operations.

Stud welding requires such a low duty cycle that heating considerations are relatively unimportant, Smith states. Total current drawn in relationship to the above figures, however, *is* important. If many operations should drive studs simultaneously, or if total amperage is in excess of the automatic tripping rating, the unit will come off the line.

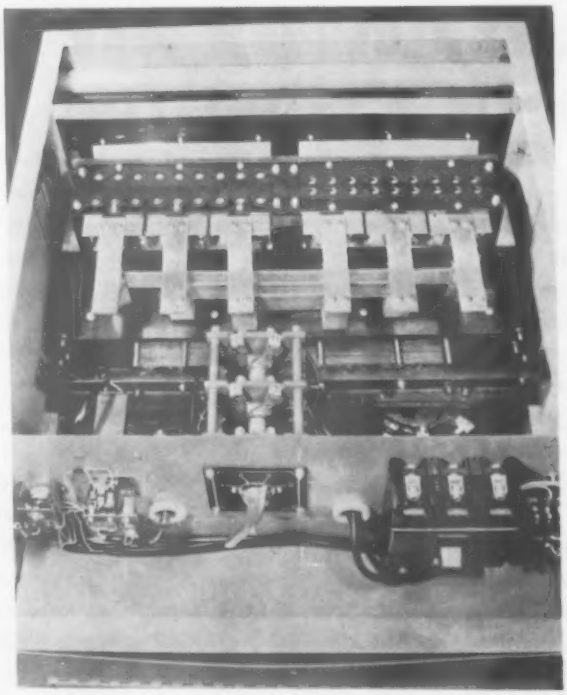
Rectifier Type

Silicon rectifiers are used in both the 750 and 1,500-amp units "for high efficiency and over-all voltage regulation to assure the same arc current for a given series resistor setting regardless of how many arcs are in operation," states A. O. Smith. The 16-gage steel housing has a smooth exterior.

High-current d-c bus bar output is privided with 4 studs, and each connection is rated at 800 amp. Each unit is thermally protected against overload, and they are made for operation in air temperatures of 104 F or less.

Smith has supplied both thermal and magnetic protection so the unit will be shut down either by long-term overloads or instantaneous short circuits with no damage to the rectifier or internal components. All transformers are insulated with silicone to withstand moisture when used out of doors.

VIEW from front of machine with cover removed shows fin-shaped silicon rectifiers in foreground, the secondary transformer connections; tap changing switch in center rear, and cooling fans in rear.



VIEW from rear shows *(l. to r.)* overload protection controls; tap changing switch; off-on switch and fan motor starter.

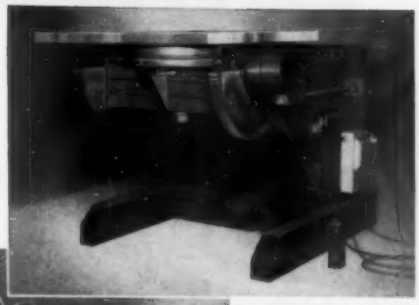
Aronson

(T. M. REG. U. S. PAT. OFF.)

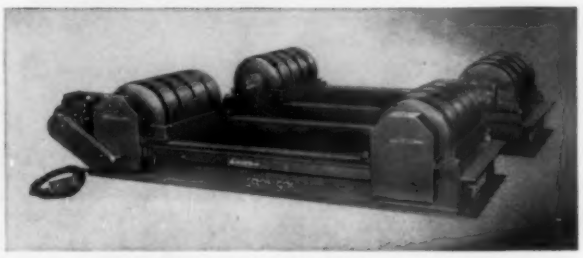
Offers You Over 200 PROVEN Standard Stock Models of Quality POSITIONERS "POSITIONEERED" to your exact Requirements

Aronson TracTred (T. M. Reg.) Turning Rolls for thin-walled heavy cylindrical work to 27 tons capacity. Zero to 100 IPM turning speed and Built-In Grounding.

Patented



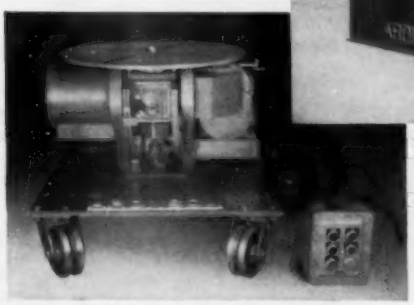
Heavy Duty Gear Driven Positioners, with Magnetic Braking, Mercury Grounding, and Optional Speeds. Capacities to 350,000 lbs.



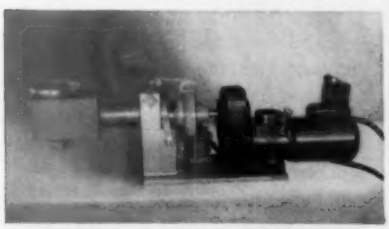
Heavy Duty Precision Built Rubber and Steel Tired Turning and Pipe Rolls, 100% overload protected. Capacities to 600 Tons.

Fully Automatic Gear Driven Positioners, featuring Geared Elevation, 135° Tilting and Variable or Constant Speed Rotation. Capacities to 350,000 lbs.

Heavy Duty Floor Turntables with precision speed control and Magnetic Braking, used for welding, burning, X-raying, etc. Capacities to 120,000 lbs., various heights and speeds.



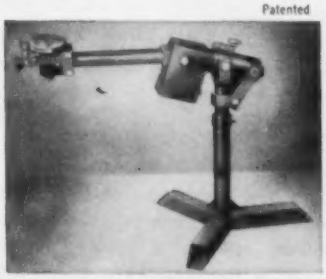
Model D Gear Driven Positioners, Compact, Precise, Rugged. Capacities to 1000 lbs.



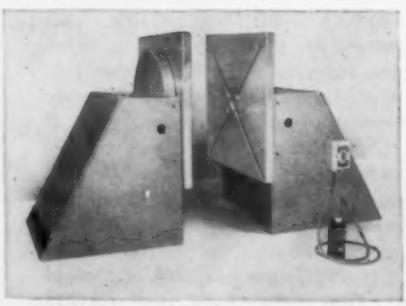
Bench Turntable Automatic Positioners with Mercury Grounding Capacities to 500 lbs.

Aronson-Twinner Permanent Magnetic Clamps, six models with thousands of uses in welding set-up work. Write for bulletin.

Patented



Aronson Universal Balance Positioners (T. M. Reg.) position your weldments effectively, instantly for downhand welding. Capacities to 2000 lbs.



Rugged Head and Tail Stock for positioning bulky weldments between centers. Table Backup for Zero Deflection, Magnetic Braking. Capacities to 160,000 lbs. Geared Elevation Optional.

Aronson MACHINE CO. ARCADE, N. Y.

(T. M. REG. U. S. PAT. OFF.)

Visit us in Booth 828 at the 1958 Welding Show—St. Louis, Mo.—April 15 to 17 and Booth 426 at the South Western Metal Exposition—Dallas, Texas May 12 to 16

VIEW of the new submerged-arc welding machine featuring automatic wire feed, flux flow and travel speed, but permitting manual guiding of arc.

Submerged-arc for broader uses

TO EXTEND advantages of high-speed, low-cost welding to jobs on which the submerged-arc process could not previously be used, Lincoln Electric Co. has manufactured a new machine: "Lincolnweld ML-3."

The mechanized unit provides automatic wire feed, flux flow and travel speed, but permits manual control of the arc.

Feeding a continuous wire to the hand-held gun, the unit is propelled at a preset speed by a small motor. A low-pressure air system flows flux from a large tank to the gun. Although flux covers the arc at all times, it does not flow ahead to obscure the seam.

Unit Features

Features of the new machine, according to Lincoln, "are intended to improve application of the submerged-arc process, extending its use and reducing the cost of many jobs now being welded by hand with conventional coated electrodes."

Speeds up to 70 ipm and currents to 600 amp are possible, and the unit can be used on materials ranging in thickness from 10 gage up. Its high maneuverability "permits the weldor to readily follow contours, or to weld any type of downhand joint and consistently meet specified bead size, speed and weld quality," says Lincoln.

The gun—an L-shaped tube approximately 1½ in. in diameter—has a nozzle tube 5½ in. long and is propelled by a motor-driven knurled steel wheel. Speed-control dial and reversing switch are mounted on the motor, as shown above.

A magnetic-amplifier control circuit reportedly keeps speed constant regardless of load or pressure on the drive wheel. Starting and stopping automatically with the welding current, the motor and drive wheel can also be rotated around the gun to accommodate different joint types.

New Flux System

Lincoln's new automatic flux-feed system — using low-pressure air — fluidizes the granular flux rather than blowing it, a feature designed to prevent clogging in, and abrasion of, the hose's inner surface.

Air flows through a dryer into a tank storing 100 lb of flux, then continues with the flux through a hose to the small reservoir on the gun. During welding, the flux drops by gravity from the reservoir to the work.

The ML-3 operates from any variable-voltage, motor-generator set or rectifier with a 400 to 600-amp d-c capacity, states Lincoln. A separate 115-volt a-c source is required for the control circuits.

The new welder is used, Lincoln states, "without fixtures, tooling and auxiliary equipment usually necessary with submerged-arc automatic heads." The firm feels that the cost of the unit—approximately $950—"brings it well within the realm of shops formerly restricted to other welding processes."

One of the first users of the new Lincoln product was Wellman Engineering Co., Cleveland, which reduced its welding costs as much as 65% on work formerly welded by manual metal-arc.

Welded Cable Drum

A typical fabrication job was done on a large cable drum. The head—a 7-ft-diameter disc of 1½-in.-thick steel plate with a large center hub and 1-in.-thick wedge-shaped stiffeners radiating from center to edge—was welded with the new unit.

Welds included a ⅜-in. fillet around each stiffener and a ⅝-in. fillet over the scarfed joint between plate and hub.

The weldor ran the machine at 550 amp with a speed of 17 ipm and welded continuously for 10 minutes to complete the bead around two stiffeners. Total time for complete welding and cleaning of 30 ft of ⅜-in. fillet was less than half an hour. The bead was reportedly a quality weld—smooth, with good shape and consistent size.

WELDOR can concentrate on guiding the arc with new unit since all other variables are automatic.

$10,400 INVESTMENT SAVED $360,000 THE FIRST YEAR!

This dramatic example of cost reduction through X-ray inspection was recently documented in the industry. Astonishing...but only one of hundreds of cases where radiography has substantially cut costs.

X-ray inspection:

- Helps welders maintain uniform high quality.
- Permits use of thinner plates (permitted under ASME codes where welds are X-ray inspected).
- Guides development of new welding techniques.
- Eliminates need for trepanning.
- Permits rapid examination of inaccessible parts in assemblies.
- Ensures customer satisfaction by preventing product failures.

IMPORTANT NOTE:—Westinghouse radiographic equipment can cost as little as $8.83 per working day, including original investment (paid off in three years) and supplies.

Talk with your Westinghouse Industrial X-ray Specialist or write Westinghouse X-ray Department for information about the full line of portable, stationary and fluoroscopic radiographic equipment. J-08363

YOU CAN BE SURE...IF IT'S

Westinghouse

INDUSTRIAL X-RAY
Westinghouse Electric Corp.
X-RAY DEPARTMENT
2519 Wilkens Avenue
Baltimore 3, Maryland

A new central control . . . wire feed units that can be taken 100 ft from their power source . . . and new gun designs are announced by Air Reduction Sales Co.

Manual Mig guns round-out Airco's line

THE DAYS of "push-pull, click-click" (sans the "click-click") are back as far as Air Reduction Sales is concerned. The company has recently marketed manual "push" and "pull" guns for the application of Airco's "Aircomatic" (Mig) welding equipment.

At a series of open houses throughout the country in late February and early March, Airco personnel explained to metalworking industry representatives and distributors the salient features of the new equipment.

The descriptive "push" and "pull" designations for the guns refer to the wire feed method. Drive rolls supplying wire for the manual "pull" gun are in the gun itself. For the "push" gun, wire drive rolls are in a "Wire Feeder" unit.

Control Unit

Drawing its power from a central, "universal" control unit, the compact and lightweight wire feeder will handle a broad range of aluminum wire types and sizes varying from 0.020-in. "hard" to 0.030-in. "soft" and up to ⅛ in. Wire guide component kits help the user adapt wire feed units to the type and diameter of wire being used.

Key component in Airco's new manual equipment line, of course, is the "universal control" mentioned above. It coordinates wire feed speed with gas and water flow, and with welding current. A unique feature of the unit is a printed circuit, which is a segment of the motor speed control.

The unit has three sub-panels, each of which can be easily removed for replacement: (1) wire-feed controls; (2) power pack; and (3) controls for programming welding operation.

Other Features

Free of control elements, the wire-feeder assumes greater effectiveness. A vernier-type speed control knob on the front panel gives the weldor a full range of speeds—up to 1,500 ipm without engaging gears. Outer scale is in hundreds, while the inner ring shows intermediate digits.

Another unit feature is instant braking of welding wire as soon as the trigger in the gun is released. This leaves the wire in position for the next weld and cuts wire waste.

NEW welding unit manufactured by Airco in action. Weldor is using the "pull" gun model in application of the "Aircomatic" (Mig) welding process.

The portable wire feeders for "push" and "pull" guns are similar. The "push" gun wire feeder is divided into three compartments: wire reel deck, motor section and drive roll section. A second model for "push" guns, designed for bulk wire, lacks the wire reel deck but is similar in all other respects. In the latter model the wire runs from a supply direct to the drive roll housing.

The "pull" gun feeder is essentially the same, except that the drive rolls are in the gun itself. By changing a few parts, a "push" gun feeder can be converted to a "pull" gun feeder.

Four Models

In each group of "push" and "pull" guns there are two models. The "push" gun models are either standard or heavy-duty types. The standard "push" gun is designed for 3/64 to 3/32-in. aluminum wires, 0.045-in. and 1/16-in. hard wires and 5/64-in. stranded wires. A heavy-duty model can handle ⅛-in. aluminum, 0.045 to 3/32-in. hard wire and 5/64-in. stranded wire.

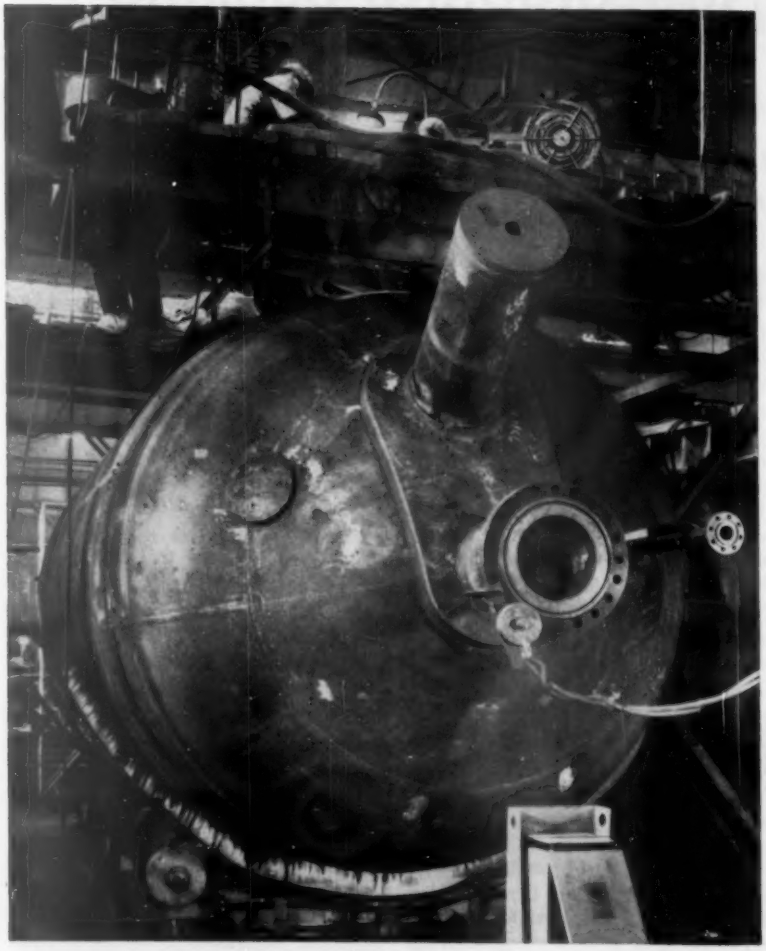
In the "pull" gun group, designed to handle finer wire, the guns are distinguished as water or air-cooled models. Both models handle 0.030 to 1/16-in. aluminum wire, 0.020 to 1/16-in. hard wire and 5/64 in. stranded wire.

The air-cooled gun is ideal when welding current requirements are at, or below, 200 amp, or when cooling water is not available. Easy change-over can be made between the two "pull" models.

For any stainless welding job

SPECIFY **Drawalloy** CORPORATION

Stainless Steel Welding Wire



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Specify Drawalloy "quality controlled" stainless steel welding wire for *your* next "quality weldments." Your greatest advantage is experience . . . our experience in producing wires for welding exclusively. Because we are specialists, Drawalloy stainless steel welding wire is produced to strictly controlled specifications to provide the right chemistry, finish and temper for the finest quality weld metal and smoother operation in your automatic or semi-automatic equipment. Drawalloy stainless wires are available in all popular grades as well as 2¼ Cr, 1 Mo; 1¼ Cr, ½ Mo.

Why not discuss your stainless welding wire needs with your Drawalloy Distributor or Representative . . . a man with the products and knowledge to help you. Bulletin 355 DC provides complete information on every grade of Drawalloy wire. Write to: Drawalloy Corporation, Lincoln Highway West at Alloy Street, York 12, Penna.

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YORK, PENNSYLVANIA

THE WIRE MILL FOR THE WELDING INDUSTRY — STAINLESS STEEL · TOOL STEEL

THREE hollow steel pins hold pipe ends proper distance apart when inserted in graphite backing rings.

VIEW of two pipe ends with backing rings inside. Pins keep short pipe sections from rolling.

WELDOR strikes are slightly down hand between pins.

DOUBLE exposure shows how hammer blow on pipe exterior breaks backing ring after welding is complete. Pieces are at lower left.

CUT sections of pipe show differences in depth of weld metal layer created by changing amperage.

Welding tubular structures has always presented problems. But now this firm says

New graphite backing rings hold a solution

By H. C. Phelps

EASE OF REMOVAL, no carbon pickup and nominal cost—these are three qualities of a new graphite-base backing ring which promises to solve many problems in welding tubular structures.

After lengthy experimenting and testing, the rings are now being used extensively by United Fabricators, Inc., of Kenilworth, N. J. Ring development was done by Carbone Corp., Booton, N. J., and Nyala Corp., Philadelphia.

To date there have been no failures or carbon pickup in the weld zones when using the new back-up rings. They are being used on mild steel pipe lines and continuous coils from 2 to 4 in. in diameter, as well as on regular pipe-section fabrication in diameters up to 6 in.

Easy Fit-up

Eliminating weld metal falling through the open joint, the rings also assist and speed fit-up time by 40 to 50%—as well as decreasing welding time by 25 to 30%, since current can be boosted 25 to 30 amp without burn-through.

The inside diameter of pipe using these backing rings are icicle-free, assuring an even flow of gases or fluids and eliminating lengthy cleaning time.

Groove Size

Tests proved a $\frac{1}{8}$-in. rounded groove in the ring gives the best weld and smooth interior. The root pass is always made with a $\frac{1}{8}$-in.-diameter electrode.

Even though the groove in the backing ring is $\frac{1}{8}$-in. deep, depth of penetration can easily be controlled. By increasing the amperage, a weldor can make welds either flush or up to $\frac{1}{8}$ in. deeper than the inside radius of the pipe—and still maintain a smooth, clean weld.

Ring design includes three $\frac{3}{32}$-in.-diameter holes spaced 120 deg apart. Into these holes the weldor places three $\frac{3}{32}$-in.-diameter hollow pins 1 in. long, formed from flat steel strip 0.010 in. thick.

Pin Spacers

The pins act as spacers between pipe ends and disintegrate on contact with the arc, becoming part of the weld metal.

The graphite backing ring also has a split joint that allows for different variations, contours and pipe ID. Use of the rings assures perfect alignment and eliminates the chance of slips or offsets in continuous lines of pipe.

Easy Removal

After welding is complete and the pipe has cooled, back-up rings are easily broken into small pieces by a sharp blow on the pipe exterior. Pieces are blown out with an air hose or washed out.

The arc cannot mark or make a flow in the ring groove since it is impossible to strike an arc on graphite. Further testing has shown the ring capable of withstanding white heat well above the arc heat.

These qualities, plus the absolute lack of carbon pickup, make graphite back-up rings a good answer to tubular welding problems.

TO ENGINEERS AND SCIENTISTS

NOTES ON PROGRESS attained in developing materials and hardware capable of functioning under conditions of high thermal stress and nuclear radiation at General Electric's AIRCRAFT NUCLEAR PROPULSION DEPARTMENT.

1000 HOURS OF RELIABLE OPERATION was clocked for this Pre Amplifier, while subjected to temperatures ranging up to 842° F and exposure to 90% of maximum radiation of Oak Ridge graphite test reactor (approximate power level 3.5 megawatts).* Performance made possible by extensive use of ceramic and refractory metal components.

Technological Breakthroughs Already Achieved at ANP Open Up New Areas for Investigation...

...and New Opportunities for Professional Men

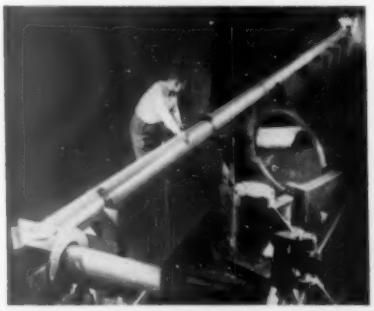
The project of using nuclear fuel for aircraft propulsion systems is an ambitious one.

Take, for example, two basic problems in metallurgical and related materials fields: how to come up with a non-poisonous brazing alloy, and how to develop delicate electronic circuitry—*both to withstand thermal and radiation extremes inherent in the small size and high-power density of a reactor for aircraft.*

The photograph above (top right) indicates how materials men at G. E. are progressing in the development of electronic assemblies suitable for application in a nuclear propulsion system. And in working toward the solution of the non-poisoning alloy mentioned, metallurgists here recently created a new, boron-free brazing alloy for reactor core components with 2033° F. M. P., 2100-2150°F. brazing temperature, and tensile strength of 60,000 psi at 1200°F.

The photograph lower left, illustrates one of the new pieces of equipment devised at G. E. to monitor tests for the ANP program.

The solution of these and many other problems was necessary before engineers and scientists at ANP could decide on the TURBOJET DIRECT CYCLE SYSTEM, which was successfully ground tested in 1957.



WORLD'S LONGEST PERISCOPE *is 90' giant, one of three large remote control optical setups used to observe reactor tests of high temperature components. Unit was designed and built at G. E.'s General Engineering Laboratory and is installed at ANP in National Reactor Testing Station near Idaho Falls, Idaho.*

PRODUCT DEVELOPMENT ACCELERATING

Much creative effort must still be expended, however, before the ANP system is ready to meet every test of practical airborne application—in reliability, efficiency, minimum weight and maximum shielding of personnel.

Technical advances already made must be applied to specific components and structures. Original investigations must be pursued in many areas.

If you recognize the scope of the technical assignments at ANP—and the satisfaction of mastering them—there may be an opening in your field of special competence.

Nuclear Experience is not essential for a majority of the following positions:

METALLURGISTS
PHYSICAL CHEMISTS
CERAMISTS
SOLID STATE PHYSICISTS

with B.S., M.S., PhD., and 5 to 10 years' experience in metallurgy or ceramics to work in:

Metal Processing: *casting, rolling, forging, extruding, swaging, plating, metallizing, brazing.*

Vacuum Metallurgy: *arc and induction melting, zone refining, brazing, sintering.*

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Peter W. Christos, Dept. 68-MP
AIRCRAFT NUCLEAR PROPULSION DEPARTMENT

GENERAL ELECTRIC

P.O. Box 132, CINCINNATI 15, OHIO

*A substantial part of the materials development behind this feasibility demonstration was carried out at ANP—and is continuing with the cooperation of other G-E Laboratories engaged in broad attack upon the problem of developing a diversity of components and mechanisms for very high temperature applications.

April is AWS convention month, and everywhere in the welding world, the word is

Meet me in St. Louis

ST. LOUIS IS A STRANGE MIXTURE of the north and the south, the east and the west, the old and the new. In the heart of America, it guards its historical tradition with one hand, and grasps modern ideas with the other.

Not content to be shrugged off as a sleepy city on the Mississippi, St. Louis recently launched an all-out attack to capture new industry. It is eager and ready to learn new manufacturing methods.

This month, the old river city will get its first good look at a comparative youngster to the metalworking industry—the method behind much modern growth. The American Welding Society selected St. Louis for its 1958 show and meeting. It is the first time a major welding show has been held in the Missouri metropolis.

Both the welding conference (April 15) and the show (April 15 to 17) will be held in Kiel Auditorium; the thirty-ninth annual meeting will be at the Hotel Statler (April 14 to 18).

For many reasons, this year's affair promises to be the best in its six-year history. Earliest indication was the almost complete sellout of exhibition space shortly after the first announcement.

Cerf to Speak

Avid TV watchers will recognize Bennett Cerf, publisher, columnist and famed panelist on TV's "What's my line?", who is slated to address the Society at its banquet following the annual President's Reception. Both reception and dinner are scheduled for April 14 at the Hotel Statler.

"The weld heat-affected zone," this year's Adams Lecture, will be given the morning of April 14 by Ernest F. Nippes, Rensselaer Polytechnic Institute, Troy, N. Y. Professor Earl R. Parker of the University of California will deliver the educational lectures on "Engineering behavior of welded structures."

"Practical shop operations" will occupy Tuesday afternoon's welding conference—the only panel of the week. T. B. Jefferson, editor and publisher of WELDING ENGINEER, is chairman of the panel of specialists who will discuss and answer questions on all welding processes. Panel members are: Howard E. Adkins, Kaiser Aluminum & Chemical Corp., Chicago; Horace Jackson, Thompson Pipe and Steel Co., Denver; H. L. McElhoe, Smith Welding Equipment Corp., Minneapolis; Gordon P. Parks, Solar Aircraft Co., Des Moines, and A. A. Wald, Caterpillar Tractor Co., Peoria.

Equipment Worth $2,500,000

Convention-goers will be busy covering the 125 exhibits—3,000 products in all, the largest assemblage of welding equipment and accessories ever staged. The display, which covers every phase of welding, is valued at $2,500,000. The show is expanding space-wise, too: it covers 33,664 sq ft, even surpassing the record-breaking size of Philadelphia's 1957 show.

Through darkened glass panels, visitors can watch actual welding demonstrations. (Be sure to read the preview articles in this issue on six important new products, four of which will be exhibited in St. Louis.)

All parts of this country and Canada will be heard from when 63 papers are delivered in the 21 scheduled technical sessions, part of the National Spring Meeting. Ninety-five authors from the U. S. and Canada will be represented. The American Society of Mechanical Engineers is co-sponsoring four of the sessions.

Crossing the Mississippi River to Granite City, Ill., on April 16, members of the industry will be among the first to see mass production of the all-welded 1958 Chevrolet automobile body frame. The following day another plant tour will cover the Midwest Piping Co., St. Louis prefabricator of welded power plant piping and pipe fittings.

Dr. Comfort A. Adams

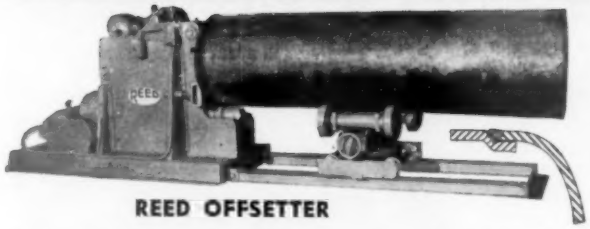
The AWS's founder and first president, Dr. Comfort A. Adams, 89, died Feb. 21 at his home in Philadelphia. A professor emeritus of Harvard University, Dr. Adams was awarded the American Institute of Electrical Engineer's Lamme and Edison medals. In his honor, last year's AWS meeting and show was renamed the Adams National Meeting.

Step Right Up . . .

There may be no old-fashioned carnival hawking at the AWS show, but there will be plenty to see. Fol-

KIEL Auditorium—scene of the 1958 AWS Welding Show.

WEBB TANK PRODUCTION MACHINERY



REED OFFSETTER

This machine forms an offset flange around shell ends to facilitate automatic welding of tank heads. It eliminates chill rings, decreases fit-up time, improves the concentricity of shell ends, and aids in reducing actual welding time. Tight, clean joints result. Three sizes of Offsetters handle up to ½" plate with standard dies. Illustrated with Turntable for reversing shell ends when both ends are to have offset flanges formed.

REED ASSEMBLY PRESS

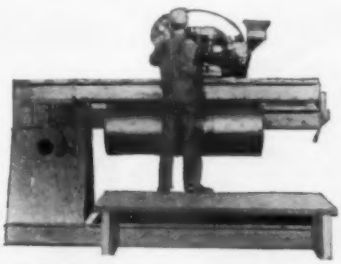
Permits rapid fit-up of tank heads into tank shells where offset joggle joints are used. Hydraulic pressure is applied through ball-and-socket swivel joints that allow the head cups to set to the head. Hydraulically powered kick-outs speed up loading and unloading. Both headstock and tailstock are adjustable vertically; tailstock is also adjustable along the bed for various lengths of vessels up to 18'.

Fit-up rolls are also available to facilitate proper alignment and assemby of shells lacking rigidity.

UNIT TYPE ROLL

A complete line of Unit Type Track Supports and Turning Roll Fixtures can be provided for the welding of longitudinal and girth seams of cylindrical vessels, to 12' in diameter and weighing up to 9 tons.

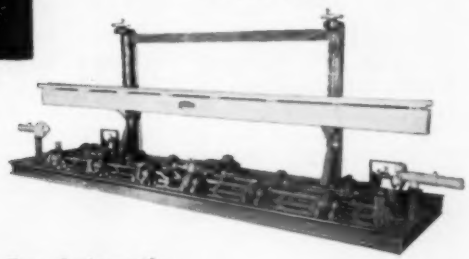
The unit is of all steel construction and all critical surfaces are machined to insure accuracy.



SEAM WELDER

These fixtures are widely used for single pass automatic longitudinal seam welding, using closed butt joints. This is designed primarily for cylindical shapes and will also handle flat work and conical shapes. The material is clamped firmly in the jig in contact with the water cooled back up bar. Machine is all steel construction.

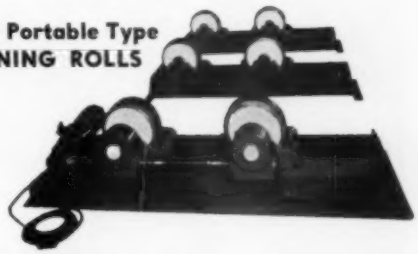
REED TRACK SUPPORTS



For Automatic Welding Head Carriages

Increase production—use this fixture on 4' to 12' diameter work. Welding track is 24' to 34' long. Powered vertical adjustment is available for all models. May be used with your present turning rolls, welding positioners, special jigs for straight seam work, or portable type rolls illustrated below.

REED Portable Type TURNING ROLLS



For manual or automatic welding and other operations requiring rotation of a cylindrical vessel. Capacities range from 3 tons to 75 tons; larger units built to special order. Powered by electric motor with variable speed transmissions. Readily portable, they may be used free or anchored to the floor as desired.

Horn Type Fixtures | Cylinder Flange Offsetters | Assembly Fixtures | Unit Type Turning Rolls | Portable Turning Rolls | Automatic Welding Track Supports

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AWS 6th WELDING SHOW

St. Louis, Mo., April 15-16-17

lowing are names and booth numbers of exhibitors: Acetogen Gas Co., 132; Acorn Iron & Supply Co., 700; Air Reduction Sales Co., 401; Alloy Rods Co., 204; All-State Welding Alloys Co., Inc., 604; Aluminum Co. of America, 105; American Manganese Steel Div., 500; American Platinum Works, 616; American Pullmax Co., Inc., 112; American Torch Tip Co., 130; Ampco Metal, Inc., 404; Arcair Co., 127.

Arcos Corp., 312; Aronson Machine Co., 828; Aro Spotwelders Div., 603; Balteau Electric Corp., 205; Banner Welder, Inc., 206; Berkeley Co., 809N; Bernard Welding Equipment Co., 209; Cam-Lok Div., 704; Cayuga Machine & Fabricating Co., Inc., 309; Champion Rivet Co., 110; Circle Clamp Corp., 717; Contour Marker Corp. of Calif., 408; Coyne Cylinder Co., 612; Dockson Corp., 725; E. I. DuPont de Nemours & Co., Inc., 109; Emerson Electric Mfg. Co., 711; Erico Products, Inc., 140N; Eutectic Welding Alloys Corp., 505; Fibre-Metal Products Co., 136; Frommelt Industries, 602.

General Electric Co., 722; Glendale Optical Co., Inc., 119; Goldsmith Brothers, 703; Goss Gas Inc., 800; Harnischfeger Corp., 305; Harris Calorific Co., 133; Heath Engineering, 608; Hobart Brothers Co., 302; Robert Holmes & Bros., Inc., 802; Independent Engineering Co., 607; International Nickel Co., Inc., 304; Jackson Products, 111; Kedman Co., 614; KSM Products, Inc., 609; Lenco, Inc., 509; Lewis Welding & Engineering Corp., 115; Lincoln Electric Co., 502; Linde Co., 815; Liquid Carbonic Corp., 610.

Biggest Ever

Marquette Mfg. Co., Inc., 506; McKay Co., 405; Merit Co., 650; Metallizing Co. of America, 827; Metallizing Engineering Co., Inc., 107; Metal & Thermit Corp., 409; Miller Electric Mfg. Co., 507; Milwaukee Electric Tool Corp., 719; Modern Engineering Co., 606; Moehlenpah Engineering Co., 615; National Cylinder Gas Co., 210; National Torch Tip Co., 713; Nelson Stud Welding, 510; Nuclear Systems Div. of Budd Co., 822; Page Steel & Wire Div., American Chain & Cable Co., 808; Pandjiris Weldment Co., 307; Philips Electronics, Inc., 407; Picker X-Ray Corp., 714; Pure Carbonic Co., 400; J. M. Ragle Industries, 710; Reid-Avery Co., Inc., 706; Robotron Corp., 412; Robvon Backing Ring Co., 139; Joseph E. Rush Co., 724; Safety Clothing & Equipment Co., 701; Sciaky Brothers, Inc., 313; Sellstrom Mfg. Co., 501; Sight Feed Generator Co., 135; A. O. Smith Corp., 125; Smith Welding Equipment Corp., 403; Square D Co., 605; Steffan Engineering, 129; Stoody Co., 617; Sylvania Electric Products, Inc., 118; Taylor-Winfield Corp., 100; Tec Torch Co., Inc., 506N.

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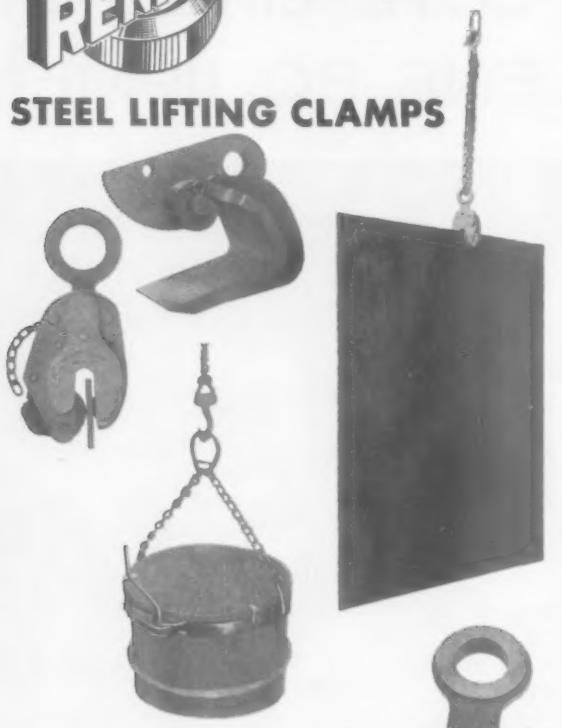

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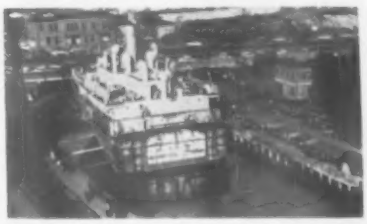
Welding helps "jumboize" tanker

OLD midbody and bow section of "Gulfmeadows" floats out of graving dock at Bethlehem Steel Co. shipyards after being cut from stern. This is first step in "jumboizing" process which cuts tanker into three parts, discards middle section and welds bow and stern to longer and wider cargo section.



STERN awaits new midbody, which will be welded on. "Jumboizing" enlarges cargo capacity of T-2 tankers to 7 million gal–1,260,000 more than before–Gulf Oil Corp., New York, reports. Firm found rebuilding a better solution than buying new tankers.

SEPARATED section moves away in background, while new 3,300-ton steel midbody floats in. Graving dock is emptied to lower new section in line with stern for welding.

AFTER bow received similar treatment as stern, the restyled, "jumboized" tanker gets underway.

✔ NUB diameter automatically sets welding gap for root pass.
✔ Robvon Backing Rings Form perfect welded-joints eliminating slag and icicles.
✔ Robvon Backing Rings Allow complete penetration and fusion.
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ROBVON BACKING RINGS

APPROVED FOR WELDED PIPE, VALVES, AND FITTING JOINTS

Available in carbon steel, wrought iron, chrome alloys stainless steel, aluminum and copper

TYPE CCC Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB conforms to the diameter of weld rod. ROBVON rings are beveled to assure non-restricted fluid flow.

TYPE CC Designed to allow quick easy alignment of pipe where the inside diameters are slightly out of round. The welder has the choice of "STRIKING OFF" the NUBS or leaving them intact to be melted into the weld mass of the first root pass.

TYPE C Designed for precise close tolerance fit-up. Type "C" NUBS conform to the diameter of the weld root. The NUBS melt with the metal to give complete penetration and fusion.

Robvon also manufactures machined rings to customer's specifications
All fabricated solid machined rings x-rayed. Write for full information

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675 GARDEN STREET ELIZABETH, NEW JERSEY

"... There were giants in the earth in those days."

Super shovel hefts tons of earth in a quest for coal

The paper on which this article is based was worth $5,000 to its author*

By Tom Learmont
Product Engineer
Bucyrus-Erie Co.
Milwaukee, Wis.

LYING BENEATH a thin skin of earth is one of our greatest natural resources—coal.

But that earth crust is more formidable than it seems. The price you pay to put coal in your factory or basement is based upon the economy with which it can be removed to get at the mineral beneath.

Such a shovel is a giant among pygmies as it grinds along, uncovering sections of coal about 90 ft wide and several hundred feet long.

But even a giant has its limitations. Chief among these is the disposal of overburden (*i.e.*, the material it has dug) into parallel areas where coal has already been removed.

This *spoil*, as it is sometimes called, can be heaped only as high as the shovel's dumping reach. And this imposes yet another limitation, because a longer reach requires a longer arm length (for overturning moment due to digging forces). And all these factors throw a tremendous load on shovel components.

Factors Balanced

For this reason, strip-mine operators rely heavily on power shovels, including several gargantuan machines which can scoop up 40 to 75 cu yd of soil and stone in one massive bite.

So, in developing basic sections of a shovel, the designer must balance, or compromise, all shovel factors: dipper capacity, boom and dipper stick lengths. In addition, he must do all this with the overburden depth—and type—encountered on any particular property included in his calculations.

These, then, were the problems facing designers when fabricating a stripping shovel for the River Queen Coal Co.'s mine near Greenville, Ky.

The unit is completely new in design. It provides for the use of a number of boom and handle lengths, and dipper combinations with 40 to 65-yd capacities.

River Queen's shovel has a 145-ft boom, a handle 86 ft long, and a dipper with a 55-yd capacity. It weighs 2,400 tons and is one of the largest pieces of mobile land equipment in the world.

**This article presents major portions of the first grand prize award paper in the recent machine design competition sponsored by The James F. Lincoln Arc Welding Foundation, Cleveland.*

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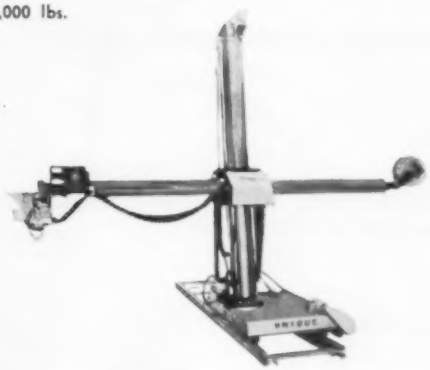

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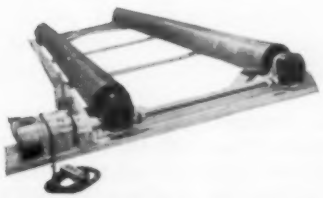

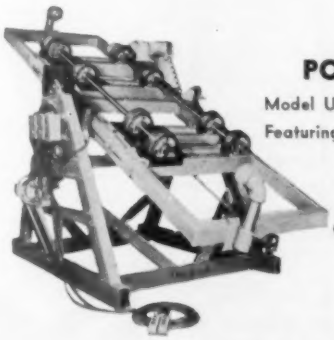

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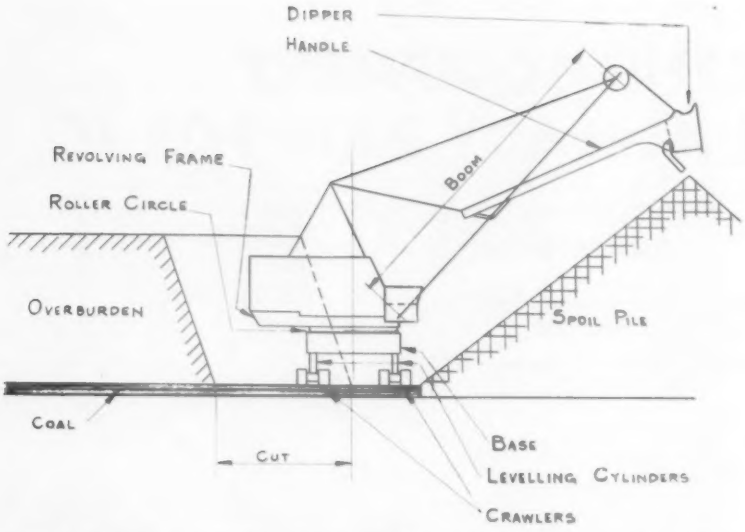


DRAWING shows stripping shovel mining coal. Also illustrated are basic components of such a shovel.

Without the flexibility and adaptability of arc welding, some design problems would have been insurmountable.

Supported by Cylinders

Perhaps the most interesting element in this respect is the 226-ton lower base which must support, without undue deflection, live loads up to 1,800 tons. These loads are subject to rapid and violent changes in character, since every 55 seconds—day in and day out—the dipper claws out about 80 tons of overburden, swings it through a 200 to 300-ft arc, dumps it, and pivots back to the digging face.

Four vertical hydraulic cylinders support and level this base. Located at each corner of the base, the cylinder's pistons rest in pockets on each of the four independently-driven dual crawler tracks. Levelling is controlled by hydraulic valves and relays actuated by switches on a mercury table.

The base, in turn, supports the revolving superstructure with a large-diameter, tapered roller-thrust bearing, known as a roller circle. Prime function of the base is to support the rollers of this bearing in a uniform manner and to transfer its load to the crawlers through corner cylinders.

Stability requirements, and space needed by crawler units, determined base dimensions. The base has a 40-sq-ft surface area and is 8 ft 4 in. thick. Corner cylinders are placed on 36-ft centers and roller circle diameter is 38 ft.

(Largest stripping shovel previously built by Bucyrus-Erie had a 34-ft roller circle diameter and cylinders on 33 ft 9 in. centers. Primarily of riveted and bolted construction, the structure comprised two heavy diagonal box-girders, which framed cylinder supports and withstood swinging loads. Deep I-beams between diagonals supported the roller circle. Stiffeners and intermediate braces prevented buckling of the I-beam webs.)

Choose Box Girders

In studies for the proposed larger base, designers reckoned they could work economies—without losing strength—by using box girders between adjacent cylinders and by eliminating the I-beams.

Torsional stiffness of the box girders would aid diagonal girders in carrying swinging loads, and the girders would also reduce bending moments under digging conditions by improving the degree of side girder end stability.

The new design would lend itself to extensive use of automatic submerged-arc welding of the heavy plates required to bear operating loads.

Because of weight considerations, some thought was given to utilizing a low-alloy steel. This idea was discarded, however, because the base had to be rigid as well as strong. Furthermore, if the advantages of low-alloy steel's higher stresses were taken, greater deflection would surely follow.

From an economic standpoint steel selection followed these rules: it had to be readily weldable . . . it had to allow broad use of standard shop practices. Uniform welding quality was an obvious goal.

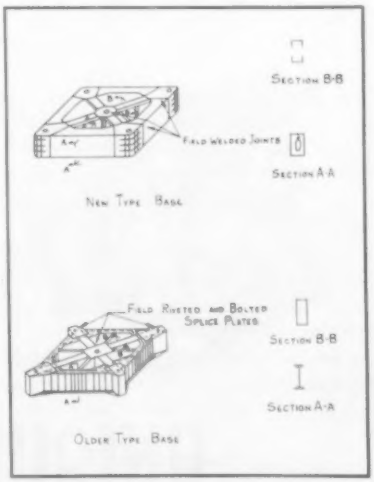
Fluctuations in loading, and the extensive use of heavy beads with submerged-arc welding, made it advisable to limit the steel's carbon and sulphur content to guard against incipient cracks which might propagate.

Therefore, all plates over 1 in. thick—about 40% of all steel used—were specified ASTM A-283, Grade B. An additional requirement was 0.045% maximum sulphur in ladle analysis. This meant some sacrifice in yield point and tensile strength over ASTM A-7 steel, but was accepted in the interests of good welding.

Good Weldability

Annealed low-carbon steel was chosen, because of its weldability, for corner castings which transmit loads to the levelling cylinder and support the center pintle. Made in the basic open-hearth manner, this steel had a carefully controlled composition.

A critical requirement was that the base be designed for assembly in the shop, for subsequent dismantling and shipment, and for *exact* reassembly



DIAGRAMMATIC comparison of new and old shovel bases structure design. By removing I-beams and by welding, unit gained equal strength, had less weight.

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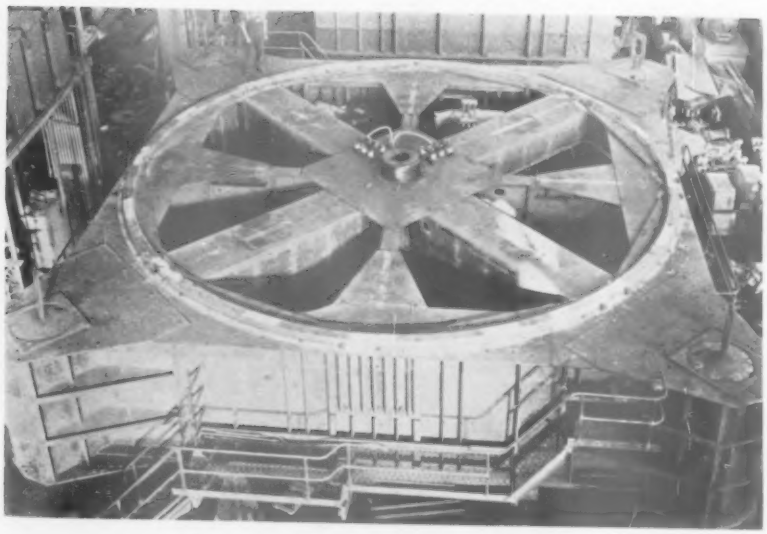

ABOVE: older and smaller base. Note holes for riveting of splice plates and I-beams. BELOW: Larger base weighs over 226 tons, yet is less expensive overall and more efficient than smaller base because of welding. Swing rack, roller circle, levelling cylinders and crawler are all in place.

in the field. This stipulation was necessary because the base was too large to transport in one section, and because it would be too expensive to ship in a number of small units. Beyond that, shop assembly was necessary so that the swing rack could be fitted and a pad under the roller circle could be machined.

The final erection scheme called, first, for setting diagonal girders, including cylinder pockets; then fitting side girders between them. This guaranteed a square structure.

It also enabled workers to fit side girders in their proper place without binding by keeping splices between side and diagonal girders more or less parallel to diagonals, rather than to side girders. Large-diameter dowel pins and lugs assisted the fitup.

Ultimately, it was decided to ship the base in eight sections—four side girders and four diagonals. To assist in shop manufacture, corner portions of the diagonals were fabricated separately, then shop-welded completely to half-diagonals.

Side Girders Identical

The four side girders are identical, with the exception of some minor holes for auxiliary attachments. A box size of 8 ft 4 in. by 5 ft was established. Webs of ¾-in. plate carry shear loads, and 2-in.-thick top and bottom plates carry bending loads.

Diaphragm plates ⅝ in. thick were provided at about 3 ft 4 in. intervals. Into the lower part of each diaphragm is cut a large manhole. To guard against cracks developing along the cut edges, ½-in. by 2½-in. bars are welded around each manhole. To insure rigid support under the rail, short beams were welded to the diaphragms directly under it.

For adequate support to the roller circle at corners, additional curved web plates with triangular-shaped top and bottom plates were added at each end of the side girders. A series of plates cut to fit the roller circle shape were welded to the top plate to provide a finished pad for the roller circle rail seat.

Web and flange plates, as well as all other large plates on the base, were purchased 2 in. wider than their final size. They were flame-cut to exact width by machine, using one torch on each side simultaneously. This eliminated possible difficulties due to camber and heat distortion.

Distortion Avoided

Welding sequences were established to avoid distortion from excessive heat on one side. By welding diaphragms and doing considerable stitching, automatic welds could be completed at each corner without turning pieces over to stagger passes.

This was a helpful plan because the pieces were too large for any existing welding turntable, and valuable time would have been lost in turning them by crane.

Good weld penetration at each box girder corner was essential. To prepare the joint at these corners, web plates were chamfered 30 deg, a ¼-in. gap was left at the root, and a ¾-in. by ¾-in. backing bar was applied.

Submerged-arc welds were made in two passes, employing a ¼-in. welding wire at 1,000 amp. Speed averaged about 6 ipm.

Manual welding was done with ¼-in. and 5/16-in. mild-steel electrodes; parts were positioned to permit downhand or vertical welding. Size of the components precluded

Insert halves are first carefully cleaned and fluxed. The sheet of EASY-FLO, .005" thick, in three sections, is liberally fluxed with HANDY FLUX. Following this, the halves are put together with EASY-FLO as a "sandwich filler" (below, left). Entire assembly is heated to a brazing temperature of 1170° F.

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EASY-FLO is put to excellent use in the die inserts (or backing plates) used in the manufacture of Columbia Records at the company's Bridgeport, Connecticut, plant. These die inserts are the heating and cooling elements used in the actual plastic record molding; in a very real sense, they are *behind* the entire record-making operation. The die insert assembly consists of two steel plates, the bottom plate being grooved to permit the passage of steam, at a temperature of 300° F under a pressure of 130 lb., followed by cold water at a pressure of 120 lb. When joined, they must be absolutely leak-tight and strong enough to stand up under thousands and thousands of stampings through drastic temperature changes and thermal shock.

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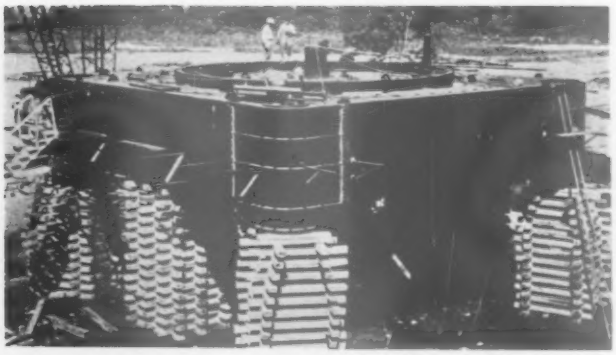


READY to be placed on crawlers, base sits loftily on 13-ft railway tie crib. Levelling pistons and crawlers will be moved into place and the base lifted by them to fit on the digger. To appreciate scale of base, compare it to the two weldors standing in background.

pre- or postheating for stress relief. Exact fitup could not be realized in every case, which meant all gaps had to be satisfactorily bridged without excessive pulling.

The possibility of distortion in machined surfaces during field welding led to a procedure in which only top and bottom flange plates were field-welded; web plates had to be joined by bolts.

Girders Meet at Center

The four half-diagonal girders, with external sections 8 ft 4 in. by 3 ft 8 in., meet at the base center and support the center pintle and center pintle bearing.

In earlier designs with smaller bases, diagonals could be shipped as one long, and two short sections with the pintle bearing contained in the longer member. In the larger base, however, weight prohibited this.

Therefore, the four half-diagonals had to be fabricated with the pintle bearing contained in one, and a bolted and field-welded connection at the center.

Since shear load carried by diagonals is relatively light, it was possible to facilitate access to compartments inside the base by using web plates of less than full depth.

Section modulus required by calculation was obtained through two U-sections facing each other and laded together. Outer flanges of the U-members were 1¼-in. plate, with vertical legs ¾ in. by 20 in. Width was enough to allow sufficient weld length on the lacing—38.5-lb tees spaced with welded diaphragms. These diaphragms had large, weld-trimmed holes to permit personnel access.

Attached to the ends of diagonals are corner girders, which are identical except for openings to accommodate hydraulic piping and electrical wiring. Because hydraulic cylinders are attached to them, considerable stiffness is required. These must be machined for close fits to transmit loads to the cylinder.

But dimensions were too large for available tools. For this reason, a steel casting was chosen as the best method of attachment, since it could be made in heavy sections with the rigidity needed for machining and operation. Also, it could be designed so that subsequent welding of the casting to the structural portion would not affect machined surfaces.

Welded in Shop

In order to ream holes by machine in the end splice-plates between side girders and corners, end-plates on side griders were initially secured to the corners with fitted bolts. Holes were then drilled and reamed. In shop assembly, these plates were welded to the side girders; when the base was knocked down for shipment, bolts were removed.

First step in the shop was to assemble the four diagonal girders. Next, corners were located by laying out the centers of levelling cylinders. Side girders were then placed, and the base checked for level and square.

Remaining side girder pieces, additional webs, end triangular pieces, and side girder end-plates were now positioned. Diagonals were welded to the corners. (Existing gaps were backed-up and filled with weld metal.)

Shop work took longer than expected. Size and weight were such that it was difficult to secure accurate lineup, thereby adding to welding time necessary for filling gaps.

To check squareness of base and center pintle bearing, a dummy pin was fitted into the bearing and a rotating tram set on it. This was also used to insure that the eight cast swing-rack segments were located in a true circle of correct pitch diameter.

After it was located, the swing rack was squared with the pintle bearing by shims. This surface was then used to support a special tool for machining the roller circle pad.

In the field, after the base is assembled and welded, levelling cylinders were lifted into place in the base and crawler units positioned under the cylinder pistons.

To accomplish this, the base had to be placed on an erection crib 13 ft high made from railroad ties. With the help of the crib, and a 75-ton derrick, the cylinders were inserted and actuated to sustain the base.

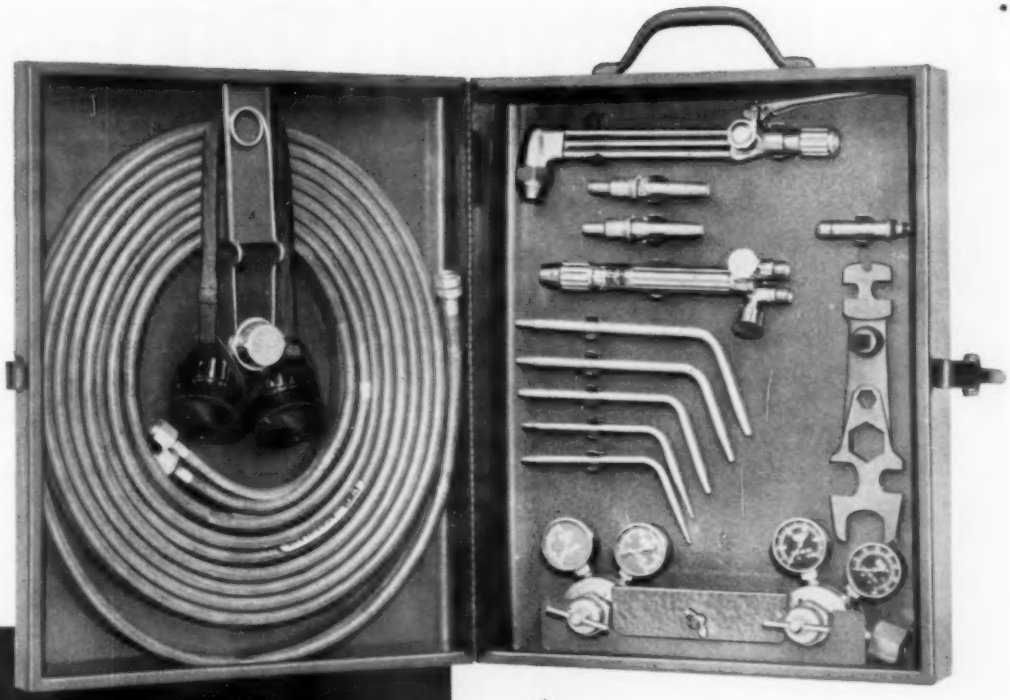
No Preheat or Postheat

Preheating and stress relieving were impractical because of the wide range of air temperatures encountered when working in the open. Throughout field-welding, therefore, E7016 low-hydrogen electrodes were used. These ranged from 5/32 to ¼ in. in diameter. On the 2-in. flange plates, a considerable number of passes obviously had to be made.

In welding upper and lower flange plates a minimum root gap of ¼ in. gave good penetration. Lower flange plates were backed by bar; upper flanges were backed by diaphragms. Each pass was carefully peened.

To determine whether the design has brought cost improvement, it must be compared to an earlier design; in this case, a smaller unit. Because prime base function is to support the roller circle, our comparisons are logically made in terms of maximum roller loads supported.

The large base described here supports 140% more roller load than the smaller unit. Its span is 36 ft as compared to 33 ft 9 in. Beam section modulus must increase with the span and with the weight supported. Beam



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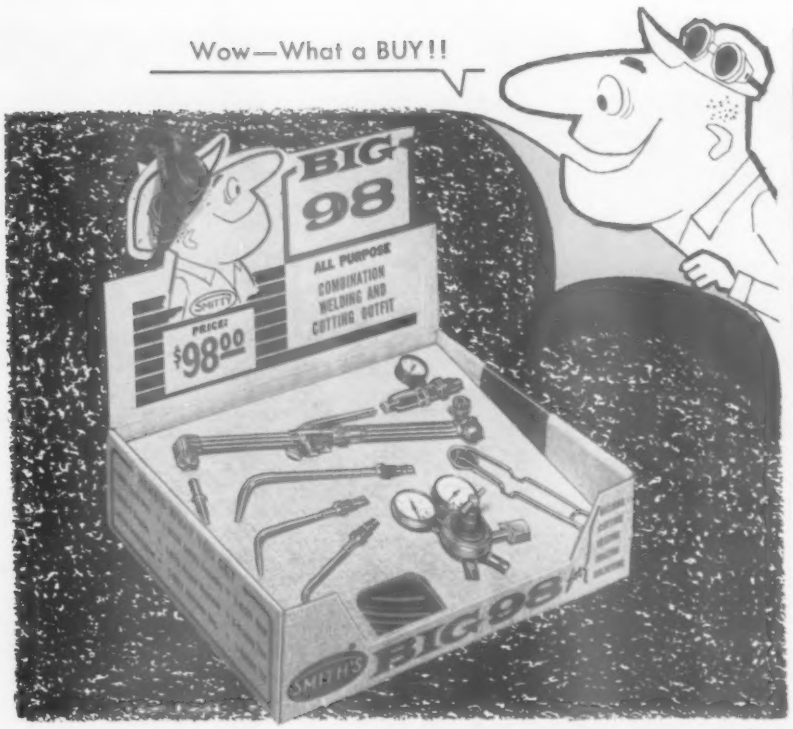

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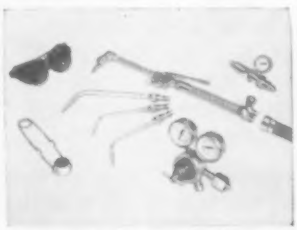

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weight also increases with its length.

Therefore, if the older design is retained, we simply increase proportions to compute increased load and span. Factor for the new design will be: 140/100 x 36/33.75—or 1.6. We can now make our comparisons.

Old and New Compared

Weight: Finished weight of the large welded base is 452,200 lb; the weight of the smaller unit: 363,500 lbs. Multiplying by the 1.6 factor, a comparable base of the older design would weigh 563,000 lbs. *Saving:* 22% in finished weight, plus lighter loads on crawlers and propulsion machinery.

Materials: Changes in fabrication methods increased excess rough material over finished material. This ranged from 10% on the smaller base to 20% on the larger base. Again applying the 1.6 factor, an estimated *saving* of 15% is realized on material costs.

Labor Hours: The large base showed an overall increase in labor hours of about 10% over that needed for the smaller base. Layout time also increased about 15%, although plate preparation time was actually reduced. This is accounted for by simpler welding layouts which more than offset the increase in percentage of excess material.

Setup and hand welding: These factors caused an increase of 15% over the time involved on the smaller base, with the addition of extra drilling, reaming, and riveting operations.

Cost per pound: Considering direct labor, indirect labor and materials, cost per lb of the two bases is almost equal. Important savings are made, however, because the larger base is proportionately so much lighter. Based on the 1.6 factor, *savings* are approximately 24%—due largely to increased efficiency in the use of materials made possible by welding.

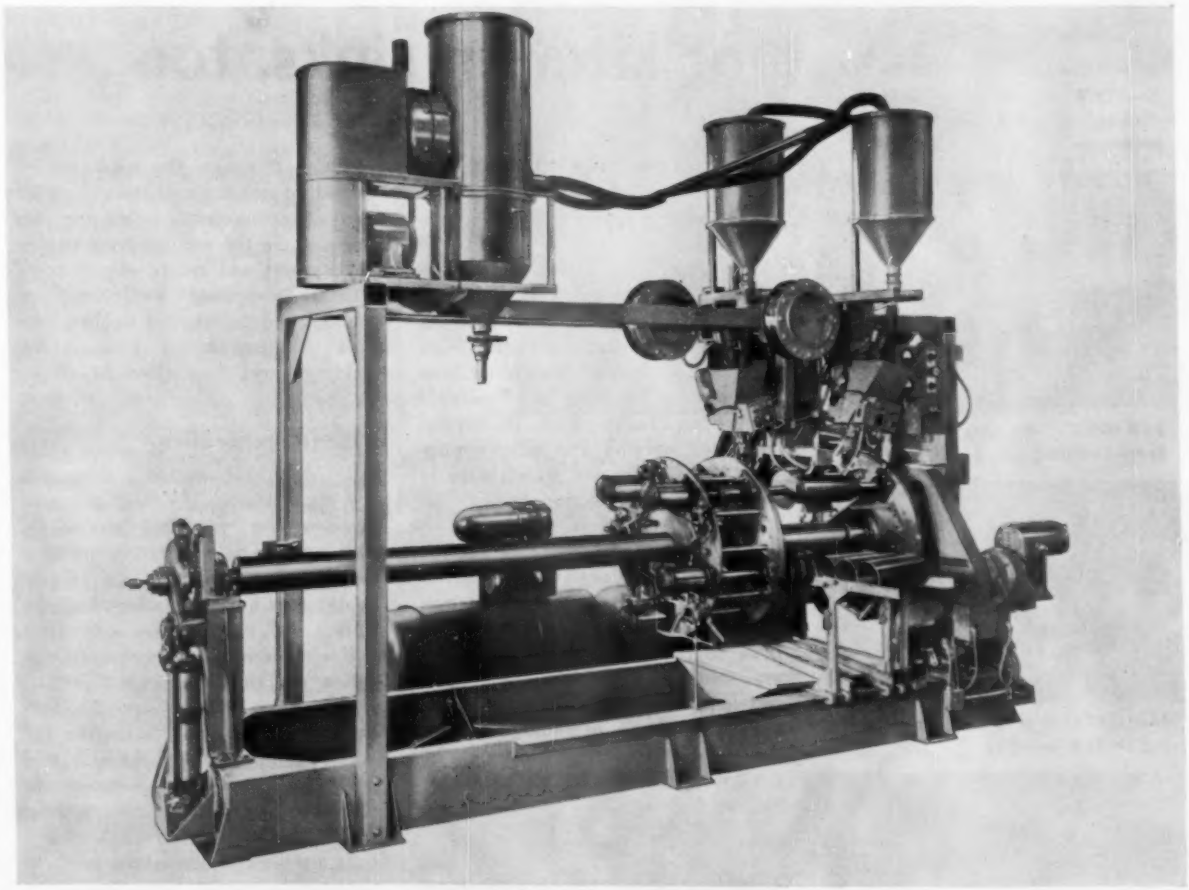
Operating costs: Labor charges per month will be almost the same for both machines, with total monthly operating costs for the large shovel being 56% greater than for the smaller.

However, the large shovel's output, based on its range and the dipper size used, can be 100% greater than its smaller counterpart. Stripping cost, then, will be only 78% of that of the smaller shovel. *Saving:* approximately 20%.

IMPORTANT ANNOUNCEMENT FOR THE WELDING INDUSTRY

Century Engineering Company announces new, expanded engineering and production facilities at its Clifton, New Jersey plant where tough problems in automatic welding are solved.

Those charged with the responsiblity of greater production at lower unit cost may get more data on Century services by dropping us a line on your company letterhead.



Century's new facilities are turning out automatic welding machines, holding fixtures and hard surfacing machines. Here is an automatic, submerged arc, welding machine equipped with an automatic flux feed and recovery that doubled the output of a large eastern roll manufacturer.

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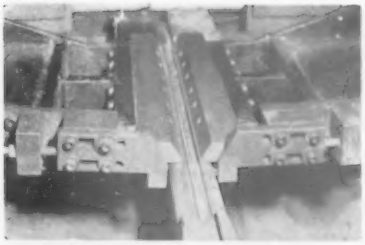
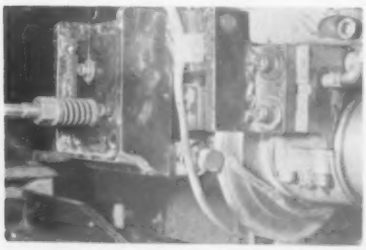


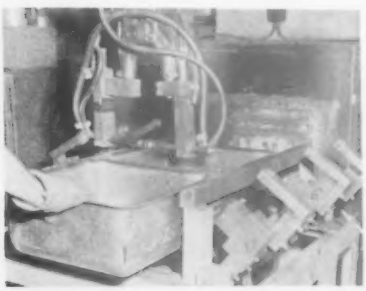
1–CLOSE-UP view of fixture for locating and clamping the two basins.

2—VIEW of the seam welder including switches and valves for sequences.



3–WHEEL dressing equipment keeps welding-wheel face clean.

4—SURFACE prepared for enameling by belt grinding.



5 & 6—FIXTURE for locating and clamping the sink and straps to be welded, including portable gun welder for making the welds.

Everything but?

No!

Engineered automation for kitchen sinks, too

A MIDWEST MANUFACTURER of kitchen sinks has found mash-seam welding pays off in added efficiency.

The firm's automated set-up depicted on these pages is the result of a search for better and cheaper means to join twin basins of the sink. With the help of resistance welding consultant Ed Sirabian of Flashweld Industries, Franklin Park, Ill., several pieces of welding and allied equipment were purchased which were to serve in the production line.

Five Stations

Now in use as designed and developed by Sirabian, the production line consists of five stations. In the first, edges to be welded are wiped clean with a solvent.

The second stage consists of the equipment shown in photos 1, 2 and 3. Photo 1 gives a close-up view of the fixture for locating and clamping the two basins.

Photo 2 shows the seam welder including switches and control valves used for automatic clamping sequence, and the welding-head stroke, table travel and return sequence, as well as equipment for control of amount and duration of welding current. Equipment for keeping the welding-wheel face clean is shown in photo 3.

Edge Preparation

In the third station (photo 4), the top surface of welded edges is prepared for porcelain enameling. This surface is belt ground with a swing-frame grinder in an exhaust booth equipped for clamping the work.

Hanger straps, which also serve to stiffen the sink, are welded at the fourth station (photos 5 and 6). This assembly is primarily a fixture for locating and clamping the sink and straps to be welded, and a portable gun welder adapted for making these welds.

At the last station, tabs used to position basins in the mash-seam welder are removed in a punch press operation.

Welding Set-up

The seam welding machine itself is a standard 200-kva, 440-volt, single-phase unit equipped with series capacitors. The lower horn was replaced with a fixture specially designed to locate and clamp the work

and provide an automatic weld-and-return sequence.

Current control can provide either uninterrupted a-c or interrupted current to give pre-set on and off cycles of a-c. The former is used although interrupted a-c results in less pick-up on the electrode.

In mash-seam welding amount of overlap is critical, so basin stampings must be trimmed uniformly. The fixture must clamp the basins rigidly to prevent any change in the amount of overlap during the length of the weld. Clamp arms can be partially seen in photo 2.

Sinks welded are either 16 or 14-gage mild steel. Amount of overlap for the 16-gage sink is 0.070 in., while overlap for the 14 gage is set at 0.094 in.

Upper electrode is a ¾-in.-thick by 10-in.-diameter RWMA class 2 alloy wheel. The lower electrode is a ¾ by ¾-in. RWMA class 3 alloy bar, set in a class 2 casting and mounted in the traveling table. The secondary loop from the casting back to the transformer is completed with bus bars and two flexible bands.

Production Standards

To keep the wheel face clean, a wheel dresser—with a milling-type cutter driven by a standard flexible-shaft grinder—was designed and mounted on the welding wheel head as shown in photos 2 and 3. With this unit, a micrometer adjustment can be made to keep the wheel face clean at all times.

Table travel speed is set—by means of a variable-speed drive—for a production rate of 45 welded sinks per hour. This speed provides ample time for the operator to remove the welded sink and load two unwelded basins during the return stroke of the table.

Such speed is also preferred to a higher production rate, since rejects due to weld defects can be reduced to practically zero.

In welding the two straps, a major problem encountered was elimination of objectionable electrode tip marks on the inside surfaces. Use of projection welding and swivel electrode tips solved the problem satisfactorily.

Swivel tips and the manner in which a standard 35-kva portable welder was adapted for this service can be seen in photos 5 and 6. The fixture is universal, so either the 16 or 14-gage sink can be accommodated with little changeover time.

How Oliver Corporation Saves $35.00 per man with...

Riegel
WELDER'S GLOVES

"The Riegel No. 99 Heavy Welder lasts six weeks against two weeks for the glove we used formerly. The men tell us it's more comfortable and cooler."

So reports Mr. Richard Thornell, whose switch to Riegel now saves $35.00 yearly per man at Oliver Corporation, Springfield, Ohio.

No. 99 facts: Heavy but flexible "flextan" welders' leather, gunn cut, wing thumb. Extra roomy, extra long. One-piece back, wool-insulated . . . all exposed seams welted . . . full protection against heat and sparks.

Riegel has the service you want, too . . . industrial specialists to help select the right style . . . eight warehouses to speed delivery. Write or phone today.

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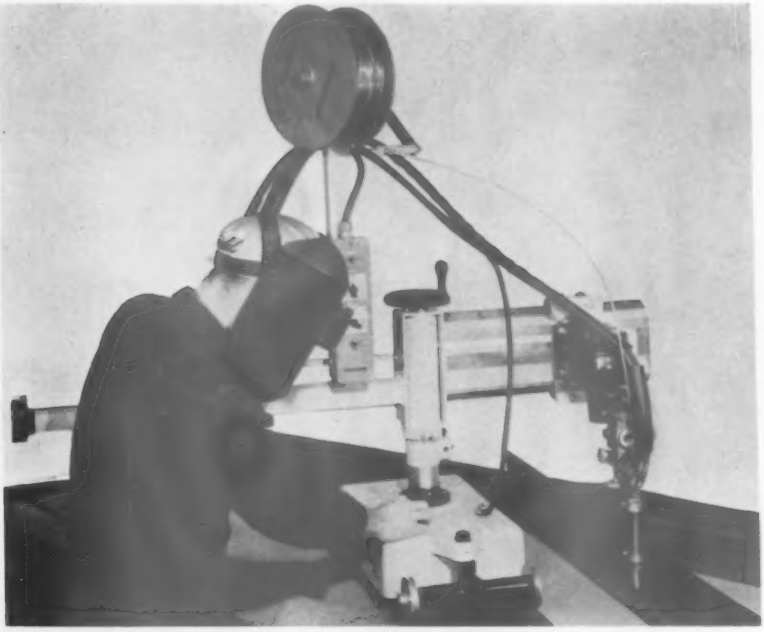
new products . . . . . USE CARD ON PAGE 155



WELDING, cutting and heat-treating equipment can be mounted on back of this versatile "Beetle," a portable, electric motor-driven, track-guided machine. Unit can carry 15 times its own weight in accessories.

All purpose unit

"THE BEETLE" is a portable, electric motor-driven, track guided machine able to do automatic welding, cutting and heat-treating. Designed to handle most shop requirements and to supplement welding and cutting equipment in large fabrication shops, the unit is available in two speed ranges. The new machine can "take the bugs out" of many jobs, including automatic welding and cutting of steel plates, cutting billets or blooms to length; automatic welding of longitudinal tank and pipe joints, railroad car sidings, etc.

Basic "Beetle" carriages can be equipped to do straight-line bevel and heavy-duty cutting with accessories, also welding, flame-hardening, softening and straightening and stress relieving. Model 25200 welds at 9 to 127 ipm and a lower-speed twin (model 25300) travels at from 1 to 14½ ipm for cutting or heat treating. Travel speed can be increased or decreased while cutting is in progress.

Machine (electric motor, controls and heavy aluminum housing) weighs 47 lb, can carry 750 lb. Beam assemblies available in 74 and 49 in. Dimensions of carriage are 23½ in. long, 14½ in. wide and 5½ in. high. *NCG Div., National Cylinder Gas Co.*

Circle No. 1

Many of these new products can be seen at the American Welding Society's Sixth Annual Welding Show to be held in Kiel Auditorium, St. Louis, April 15 through 17.

Welding outfit

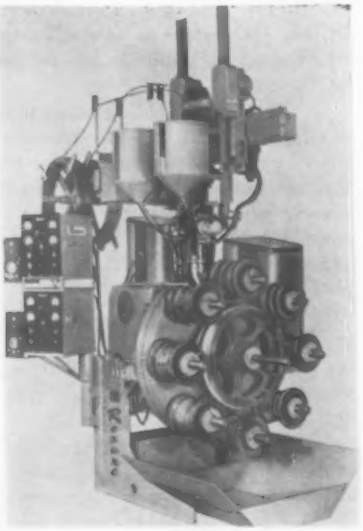
ALL-purpose welding and cutting outfit includes standard torch handle, three welding tips, cutting assembly, one cutting tip, oxygen regulator, pre-set acetylene regulator, goggles, torch lighter and hose. Called the "Big 98 for $98," the outfit welds, burns, heats, brazes, solders, etc. Welding range is 1/32 to ⅜ in. Cutting range is ⅛ to 1 in. Special tips adapt torch to scarfing, rivet washing and gouging. *Smith Welding Equipment Corp.*

Circle No. 2

Soldering flux

NON-corrosive soldering flux for stainless and nickel-chrome alloys has an organic base. "Anchor No. 302" flux strips tenacious oxides from stainless steel, steel, nickel and nickel-chromium alloys. No zinc or ammonium chlorides, acids, or rosin are used. Flux supplied in concentrated ready-to-use form. *Anchor Metal Co., Inc.*

Circle No. 3



THIS automatic roller and idler welder and positioner can mount eight tractor rollers and one idler at a time.

Welder and positioner

ABLE to mount eight tractor rollers and one idler at a time, a new "Twin Head" automatic roller and idler welder and positioner builds up both sides of worn tractor roll simultaneously and automatically, firm says. By the time the first roller hardfaced reaches the 8th index position, it is sufficiently cooled to receive the second welding pass, firm reports.

Twin welding heads operate simultaneously or independently. Welding heads are power operated both vertically and horizontally by controls as well as indexing of turret, and tilting of the versatile positioner. Welding head carriage has motor drive. Tilting table positions from 30 deg below horizontal to any position through vertical position. Thus, rebuilding of roller flanges is done automatically.

Unit can hardface or weld on idler up to 38 in. in diameter without removing spindles. Round weldments up to 46 in. diameter may be handled by removing all eight spindles. *Sight Feed Generator Co.*

Circle No. 4

Thickness gage

PRECISE, non-destructive measurement of thickness of coatings and platings on base materials can be done with a new instrument, the "Laminagage." *Gulton Industries.*

Circle No. 5

Brazing alloy

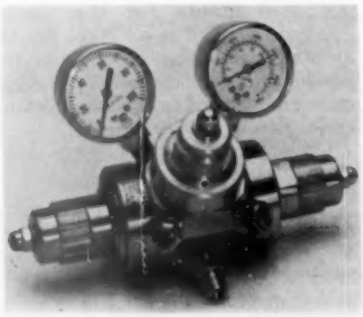
NICKEL-base material containing chromium borides is suitable for use in fabricating such parts as turbine blades, rotor shafts and high-stressed sheet metal structures, manufacturer says. It is available in powder, rod, paste or plastic bonded wire. The high temperature service brazing alloys have high strength and oxidation resistance applications where erosion must be controlled. It resists oxidation to 1,800 F plus. Joints are ductile, permitting 720-deg twist without fracture. Joint strength is 34,000 psi tensile shear. Recommended by manufacturer for furnace brazing in either pure dry hydrogen or in vacuum atmosphere. It can also be used for torch brazing in air when used as paste. *Wall Colmonoy Corp.*

Circle No. 6

Torches

MODEL F-10 is one of two new "Super flaming" torches. It is designed to operate on vapor gas at from 25 lb to full tank pressure on any standard cylinder. Model F-20 operates on LP gas from liquid withdrawal cylinder. It converts liquid gas to vapor in the pre-heated vaporization chamber of the burner, eliminating tank freeze up. Rated up to 800,000 btu. *Wemco Products.*

Circle No. 7



Gas regulator

TWICE the delivery volume with half the normally expected pressure variations are the manufacturers' claims for a new regulator with one high-pressure and two low-pressure assemblies. The low pressure stages are inter-connected but their seating mechanisms do not work in unison. This feature is said to permit use as accurately at very low delivery volumes as at maximum delivery volumes.

The regulator is intended for use where intermittent volume requirements greatly exceed the volumes available in standard two-stage regulators. *National Welding Equipment Co.*

Circle No. 8

Hackney MILWAUKEE

streamlined high pressure gas cylinders* cut distributors' shipping costs

There was a time when backbreaking weight was a sign of safety in high pressure gas cylinders.

Then HACKNEY deep, cold drawn process eliminated costly excess weight without sacrificing *safety and durability.*

As a result, high pressure gas distributors are able to:

- save money on shipping charges
- reduce handling costs—minimum manpower needed
- cut maintenance costs—smooth surfaces easily cleaned and painted
- speed handling—more product per pound of steel
- make faster deliveries customers appreciate

More reasons for owning HACKNEY High Pressure Gas Cylinders

- Uniform cylinder capacity—simplifies filling.
- Surface free of crevices, ridges—always looks attractive.
- Light weight—easier to handle.

*Available in all shapes and sizes to meet your customers' requirements—from small medicals to 220's and 250's (cu. ft.) for oxygen, hydrogen, nitrogen, helium, argon and carbon dioxide.

Uniform sidewall thickness—from top to bottom, side to side of cylinder. Shown: typical section of Hackney cold drawn cylinder showing uniform wall thickness.

For complete specifications of Hackney cylinders for high-pressure gases, prices and other helpful information, write to:

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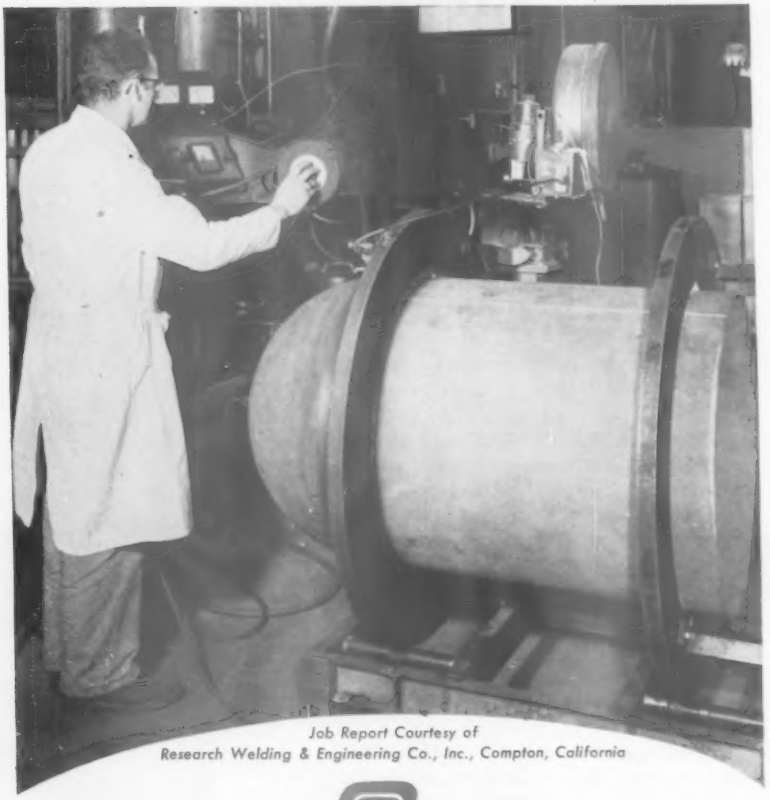
CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

For flawless high strength weld metal in missile components



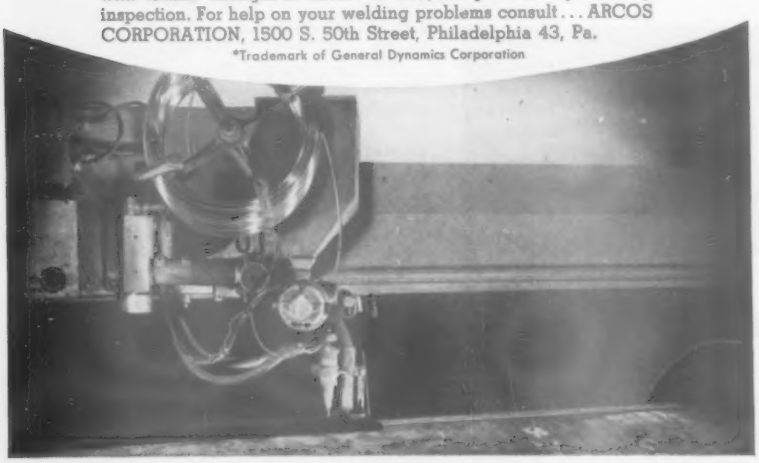
Job Report Courtesy of
Research Welding & Engineering Co., Inc., Compton, California

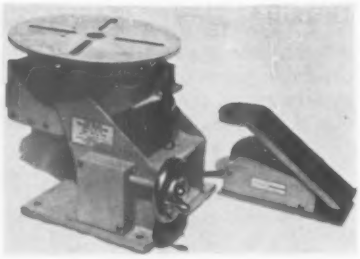
WELD WITH ARCOS

CHROMENAR Spooled Wire

Light weight was important in this welded missile component that was required to hold air under 3,000 p.s.i. pressure. After making the root pass weld with the Arcos EB* consumable insert, the weld was completed by submerged arc welding with Arcos CHROMENAR CMV welding quality wire. CHROMENAR CMV was selected because its weld metal could be heat treated to match the base metal with tensile strength in excess of 200,000 p.s.i. and pass x-ray inspection. For help on your welding problems consult... ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.

*Trademark of General Dynamics Corporation





Weld positioner

ADAPTABLE to either manual or automatic welding, a new welding positioner has 100-lb capacity. Variable-speed drive system is enclosed in welded steel frame. A turntable with manual tilt device is 12-in. in diameter and carried on anti-friction bearings. Speed range of 0 to 1.41 rpm is for manual welding of steel or low speed aluminum welding, from 0 to 10.5 rpm for high-speed automatic welding. Positioner weighs 75 lb. An auxiliary foot control is available. *Raco Engineering Service.*

Circle No. 9

Soldering control

PROCESS for standardization and quality control in production soldering applications is based on use of firm's paste-type solders and automatic and semiautomatic dispensers. Metered amount of paste solder is pre-placed inside the joint area. Amounts as small as 4/100 oz can be metered exactly, firm says. Parts are passed through controlled heating cycle and allowed to cool, completing cycle. *Fusion Engineering Co.*

Circle No. 10

Rectangular stud

REINFORCING bars up to $\frac{3}{8}$-in. in diameter can be secured to steel surfaces with a new rectangular "Rebar" stud. It eliminates hand welding of fasteners and tying bar. Type R4L stud measures $\frac{3}{4}$-in. wide and $\frac{3}{16}$ in. thick. Recommended minimum distance from weld base to edge of jaw is $\frac{7}{16}$-in. Studs may be obtained with dimensions of $\frac{11}{16}$-in., $\frac{15}{16}$-in., $1\frac{3}{16}$-in. and $1\frac{7}{16}$-in. *Nelson Stud Welding Div.*

Circle No. 11

Wire and cable

RELIABLE in temperature ranges from —90 to 250 C, a new line of insulated wire and cable is being marketed under the name "Tefwire." Type E has a wall thickness of 0.010, rated at 600 volts and type EE has wall thickness of 0.015, 1,000 volts. *Stretch Wire Corp.*

Circle No. 12

Ultrasonic gage

THICKNESS gaging, recording, detection of laminar flaws is possible with a self-contained ultrasonic gage for automated production. Rack-mounted "Model R Vidigage" is comprised of ultrasonic resonance gaging and indicating circuitry, strip chart recorder, gating and alarm circuits and calibration control. The 225-lb unit measures 21 by 24 by 68 in. high. Its power input at 60-cycle, 100-130 volt a-c is 500 watt. Thickness of metals, glass and plastics between 0.005 in. and 2.5 in. can be measured. *Branson Instruments, Inc.*

Circle No. 13

Flux dispenser

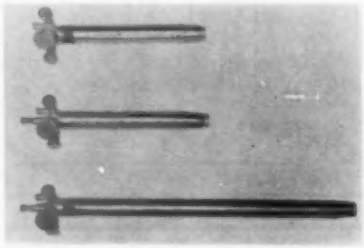
"MODEL 69" Gasfluxer Assembly dispenses liquid flux through fuel-gas line for brazing steel and other metals with bronze rod and with silver solder. Unit includes fluxing machine and reserve tank. Assembly is fabricated from steel tubing and plate. Head of unit is fitted with three valves for regulation of amount of flux or for by-passing gas completely when no flux is needed. Sight glass provided to observe liquid level of unit. *Gasflux Co.*

Circle No. 14

Heating elements

LATEST in a series of iron-chromium-aluminum electrical resistance alloys is known as "875." It was developed for use as heating elements in industrial furnaces, kilns, etc. *Hoskins Mfg. Co.*

Circle No. 15



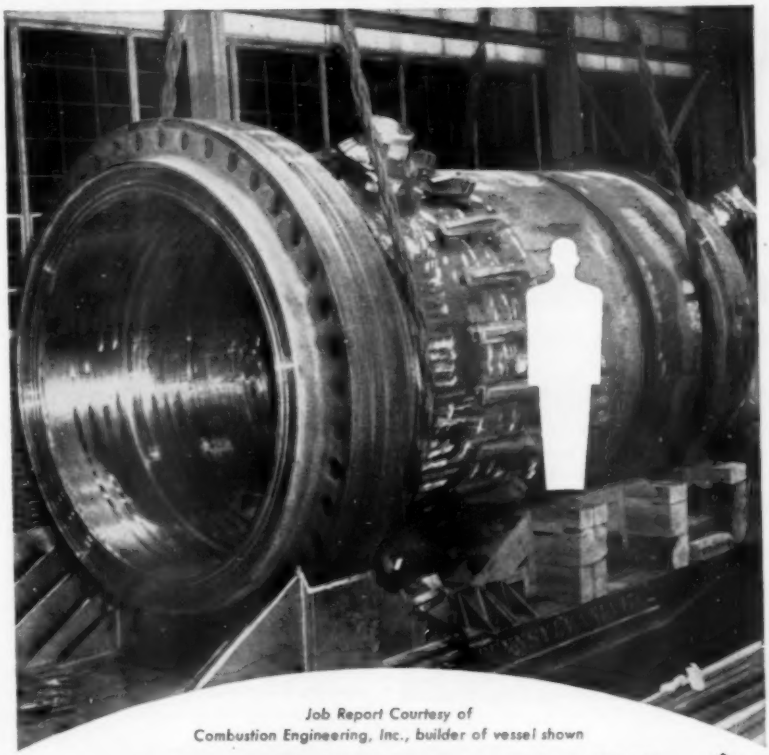
Cutting torches

SERIES of machine cutting torches features both straight bore and divergent type cutting tips. Designed for use with natural gas, city gas, propane and liquefied petroleum gases, equipment operates under either low or positive pressure.

Two- and three-hose models available in style "2500" machine cutting torches. Straight-bore type tip, available in seven sizes, is for cutting steel up to 16 in. thick, while divergent type (with a range of eight sizes) is for cutting steel up to 8 in. thick. *Air Reduction Sales Co.*

Circle No. 16

This WELDED nuclear pressure vessel holds a practical idea for you

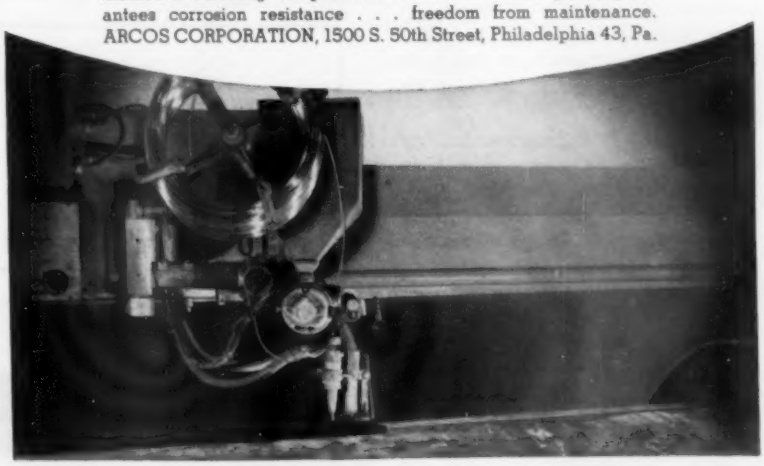


Job Report Courtesy of Combustion Engineering, Inc., builder of vessel shown

USE ARCOSITE FLUX

for submerged arc welding

In nuclear installations where radio activity makes weld failure dangerous to personnel and can cause indefinite shutdown, sound corrosion resistant welds are of utmost importance. To inhibit corrosion, portions of the 9 ft. dia. interior of this 33 ft. reactor were overlaid with ¼ in. of 308L weld metal. Submerged arc welding with ARCOSITE S4 flux was used for the job. The girth and longitudinal joints of the low alloy steel plates were also submerged arc welded using ARCOSITE B5 flux. Cost-wise, no other conventional method of cladding was practical. Arcos weld metal quality guarantees corrosion resistance . . . freedom from maintenance. ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.



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Select the Correct

Fuse-Well

CAST IRON WELDING RODS OR ELECTRODES

FUSE-WELL NO. 11

FUSE-WELL No. 11, *Square*—Gray Cast Iron Welding Rod for Acetylene use in filling or building up new or worn castings producing machineable welds.

FUSE-WELL NO. 12

FUSE-WELL No. 12, *Round*—Has the same uses and analytical ingredients as Fuse-Well No. 11.

FUSE-WELL NO. 14 MOLY

FUSE-WELL No. 14, *Moly*—An Iron Base Rod with alloys added for finer grain structure and greater strength.

FUSE-WELL NO. 22

FUSE-WELL No. 22, *Electrode* — Light coated Rod to be used for AC or DC welding in the fabricating and repairing of cast iron castings.

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WHO COULDN'T? Without much effort on your part you can earn extra money as a representative to accept and send in subscriptions to WELDING ENGINEER. Simply contact your friends and fellow workers to obtain WELDING ENGINEER subscriptions and make a nice profit for yourself.

No experience is required. We will provide you with a handy sales kit which will give you the necessary instructions. Simply mail the coupon on page 134.

Turning roll

LINE of unit frame turning rolls positions cylinders for welding. They are designed for load capacities up to 20,000 lb and to handle cylindrical vessels from 3 in. to 6 ft in diameter with lengths up to 20 ft. Various sizes of rubber and steel tires are featured. Four center-distance settings are standard for setting up various diameter vessels. Variable-speed transmission powers the rolls with speeds from 0 to 100 ipm weld travel. All models have a safety disconnect switch, magnetic reversing starter, 20 ft remote control station on 110-volt control circuit. *Aronson Machine Co.*

Circle No. 17

Wheel grinder

PIPE and tube rotary cut-off wheel grinder is designed especially for sharpening pipe and tube rotary cut-off wheels. It has manual bevel adjustment and set screw stop that permits equal length bevels on both sides of blade. Adjustable base compensates for grinding wheel wear. Grinder sharpens 4½- to 8-in. wheels. Adapter is available for smaller wheels. *Continental Machine Co.*

Circle No. 18

ONE MULTITRON
GAMMA RADIOGRAPHY MACHINE
GIVES VERSATILITY,
PORTABILITY AND ECONOMY

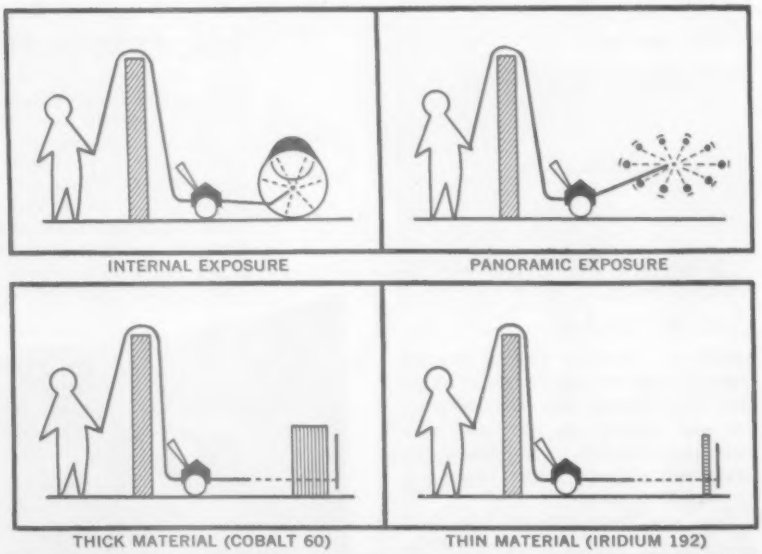
Nuclear Systems' Model 52 Multitron gamma radiography machine offers this time and labor saving combination for a wide variety of quality inspection.

The Series 50 Multitrons can utilize from one to four sources of Cobalt 60 and Iridium 192 in various combinations and strengths.

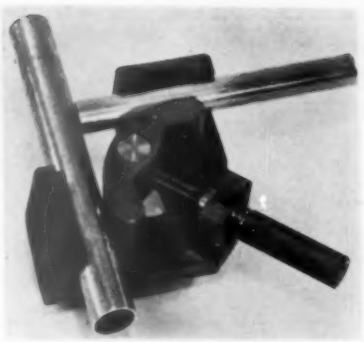
Extensive use of this machine is being made not only by shipyards such as Newport News and New York Shipbuilding, but by other manufacturers requiring quality inspection of castings or weldments.

Call on Nuclear Systems for your radiography equipment needs. Company offices in Philadelphia, Chicago and San Francisco. Sales representatives in principal cities. Catalog upon request.

Visit our booth at the Welding Show, St. Louis, April 15-17.



NUCLEAR SYSTEMS
A DIVISION OF THE BUDD COMPANY Philadelphia 32
Budd



Vise

ANGLE vise sets square or mitered channel T and H profiles, rounds square or hexagon sections, of equal or dissimilar diameters, at right angles to each other. No tack welds needed. Vise is operated by turning handle to the left to open and to right to close. Upper holding arm swivels on a center pivot and is cut away to permit automatic adjustment to varying profiles. Center locking arm may be reversed when holding larger diameters.

Base of the large model, type 2, is machined with prismatic grooves which serve to center rounds. Type 1 weighs about 5 lb, type 2 about 14. *Belmont Abrasives.*

Circle No. 19

Valve line

COMPACT solenoid valve line permits full flow of air, water, oil and other common media. Called the "L" series, the new valves are 2-way, normally closed, pilot-operated. The first valves weigh only 1¾ lb and are only 3 31/32 in. high, but they give a full ½ in. orifice with either ⅜ in. or ½ in. pipe taps. Firm also produces compact "L" series valves for normally open operation. *Skinner Electric Valve Div.*

Circle No. 20

Punch press

FEATURED on 40-ton double crank, open-back, inclinable punch press are extra large die area and new electrically controlled air operated friction clutch. The "4B" has a double crank design, bed area is 16 by 48 ft, face of ram 14 by 36 ft along with die space of 12 in., and clearance between housings of 36 in. *Service Machine Co.*

Circle No. 21

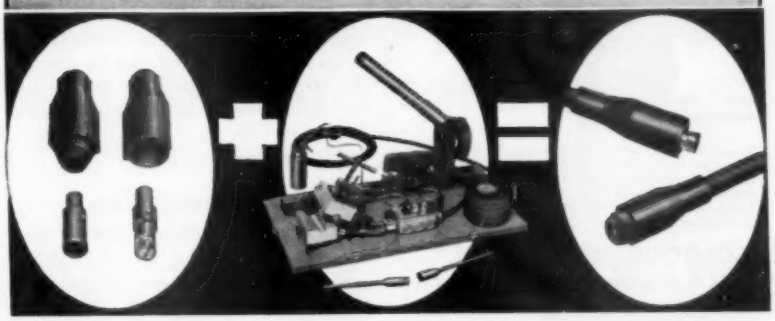
Many of these new products can be seen at the American Welding Society's Sixth Annual Welding Show to be held in Kiel Auditorium, St. Louis, April 15 through 17.

cam-lok

neoprene insulated

CABLE CONNECTORS

. . . the smoothest connection you can make!



Tapered and Vulcanized . . . Trouble-Free

No more bulky cable connections to "foul up" on obstructions and delay production. Now you can make shockproof, waterproof cable connections in your own plant in minutes with a 110 volt portable Vulcanizing Kit. Seals prefabricated neoprene insulating sleeves to cable jackets . . . cable breakage at connector is eliminated . . . cable jackets cannot pull away. Connectors lock tight—stay tight! Join all cable sizes instantly without adaptors.

Write for free catalog and see how simple, convenient and foolproof these connectors are to use. Vulcanizing Kit can also be used with an adaptor mold to make neoprene insulated, waterproof *Cable Splices!*

Visit our Booth #704 at the American Welding Society Convention April 14 thru 18, Kiel Auditorium, St. Louis, Mo.

cam-lok DIVISION

EMPIRE PRODUCTS, INC.
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Really FIVE TOOLS in ONE

Yes, actually a BOYCE Centering Head replaces

- ✓ The Protractor
- ✓ The Centerhead
- ✓ The Center Punch
- ✓ The Level
- ✓ The Scale

Determines Center Line at any Degree and Measures Degree of Declivity

Weighs only 9 ozs. Pocket size.

DIAL SET LEVEL

Y type head accurately machined with tangents and tips for centering and aligning. Dial Set Level in graduations of 2½ and 10 degree markings. Punch of Drill Rod with hardened point—insuring long service. Send for complete description.

CONTOUR MARKER CORP.
1843 E. Compton Bl., Compton, Cal.
Also Mfgs. of Contour Markers, Radius Markers and Pipe Flange Aligners.

BOYCE CENTERING HEAD

Could I use extra money!

Mail to: WELDING ENGINEER, Box 28, Morton Grove, Ill.

Name _____ 4/58

Street _____

Town _____ *Zone* _____ *State* _____

Plenty of people I know are interested in welding. They shouldn't be without WELDING ENGINEER, of course! Please send me, FREE, all the equipment I need to introduce them to *WE*. Naturally, it is understood that mailing this coupon *does not* obligate me to use or return the materials.

Cam clamp

UTILIZING interchangeable, soft metal pads, a new cam type clamp is available in sizes from ¼ to ⅝ in. With new soft metal pads, practically any shape can be made and then reworked indefinitely to depletion, manufacturer says. Heat-treating can be applied for durability. Clamp has an end slot for lateral adjustment. *Jergens Tool Specialty Co.*

Circle No. 22

Ultrasonic soldering

DESIGNED for soldering without flux, ultrasonic soldering iron is for use on aluminum and magnesium and their alloys. Ultrasonic vibrations break the oxide layer of metals and alloys that form refractory oxides, and enable such metals to be effectively soldered without any special surface pretreatment, firm says. Other applications include surface tinning and filling of blowholes in aluminum and magnesium castings, soldering light metal pipes or gutters. *Gulton Industries, Inc.*

Circle No. 23

Multipress

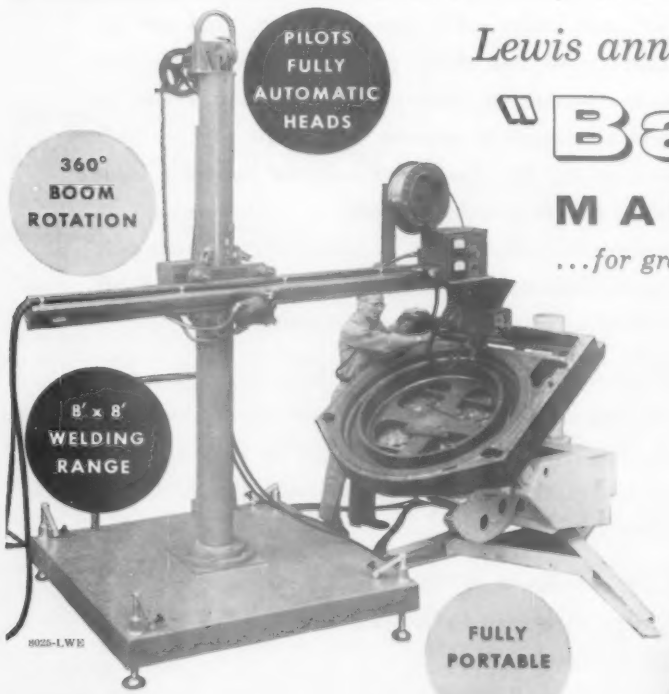
ONE- and two-ton hydraulic multipress handles a large variety of small part forming, assembling, etc., firm says. Designed for assembling, punching, marking, trimming, pelleting, testing, straightening, etc., the one-ton press can be set from 500 to 2,000 lb ram pressure, the two-ton from 500 to 4,000 lb ram pressure. *Denison Engineering Div., American Brake Shoe Co.*

Circle No. 24

Lewis announces the versatile new

"Bantam" MANIPULATOR

...for greater savings in automatic welding



Fabricators get new versatility for automatic welding operations . . . at remarkably low cost . . . with the LEWIS "Bantam" manipulator. Designed to handle diversified fabrications, short production runs and special jobs, this machine features infinitely variable welding speed . . . extreme accuracy with boom-tip loads up to 250 pounds . . . manual or powered elevation.

FOR DETAILS, SEND FOR BULLETIN 7703.

IT'S ALMOST MAGIC! SEE THE NEWEST AUTOMATIC WELDING CONTROLS . . . IN THEIR FIRST PUBLIC DEMONSTRATION . . . DURING THE 1958 A.W.S. SHOW.

BOOTH 115
APRIL 15-16-17 • ST. LOUIS, MO.

LEWIS

THE LEWIS WELDING & ENGINEERING CORP.
111 Northfield Road • Bedford, Ohio
DESIGNERS • ENGINEERS • FABRICATORS • MACHINISTS

Weld torch

WELL adapted to construction work is new welding torch "No. 43." It will operate on high, medium or low pressures. The torch handle is solderless and all joints are sealed with "O" rings. Parts can be replaced on the spot, manufacturer says. Corrugated-type thread through the packing area of valves prevents end play. An anti-friction thrust washer is used between union nut and mixer. *Harris Calorific Co.*

Circle No. 25

Contour wheel dressers

LEFT- and right-handed contour wheel dressers are for large vertical grinders. They are designed for multiple-wheel grinders and for grinding applications which cannot be handled by a single spindle grinder. Units feature automatic hydraulic operation, tied in with the grinder cycle. Contours are produced by reduction of contour template through an inclined plane mechanism. Dressing diamonds are pre-set in an optical fixture so no dresser re-adjustment is necessary when changing diamonds. Accuracies to 0.0001 in. are possible, manufacturer says. Models 93 and 95 are applicable to contours up to 2½ in. width and 2 in. depth. *Hoglund Engineering & Mfg. Co.*

Circle No. 26

Aluminum flux

SOFT solder aluminum flux will work with any aluminum solder, particularly the ones containing zinc, manufacturer states. Flux has rapid capillary action, and corrosive action is no different than any flux containing chlorides. *American Solder and Flux Co.*

Circle No. 27

CUT COSTLY DOWN TIME

...get stronger welds faster with Bridgeport No. 192 Low-Fuming Bronze Rod

A cast steel valve chamber, controlling fluid from a 1200 psi pump, spelled shutdown for an entire operation when it developed a crack. Instead of replacing the unit at considerable expense in both money and time, a shop welder repaired it quickly, cheaply and permanently with Bridgeport No. 192 Low-Fuming Bronze Rod.

Bridgeport No. 192—recommended for all-purpose welding—is a low-fuming manganese-type rod that tins readily with only local preheating. Because the temperature of the surrounding metal requires relatively little preheating, brittleness is avoided. This also means a saving in gas and labor, and often produces a weld stronger than the base metal.

You can have the whole money-saving story of Bridgeport No. 192 Low-Fuming Bronze Rod and other Bridgeport Alloys in our new booklet, "Bronze Welding—Modern Tool of Industry." Write for your free copy today.

HANDY GUIDE TO BRIDGEPORT WELDING ALLOYS

ALLOY	Welding Method	Approx. Melting Point °F
192 Low Fuming Manganese	GAS	1600
191 Manganese Bronze (Navy)	GAS	1600
196 Bridgeport Bronze	GAS	1600
656 Silicon Bronze (3% Si)	GAS or ARC	1865
548 Nickel Silver	GAS	1675

Bridgeport BRASS Co.

BRIDGEPORT BRASS

Offices in Principal Cities • Conveniently Located Warehouses

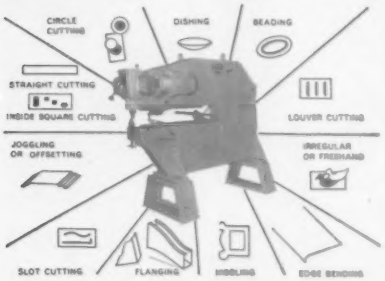
Bridgeport Brass Company, Bridgeport 2, Conn. • In Canada: Noranda Copper and Brass Ltd., Montreal

BRASS • BRONZE • COPPER • SHEET • ROD • WIRE • TUBE • ALUMINUM EXTRUSIONS AND FORGINGS

A COMPLETE SHEET METAL SHOP IN ONE MACHINE

PULLMAX

DOES ALL OF THESE OPERATIONS



★ CUTS MILD STEEL UP TO 11/32"

The one machine that's sure to save time, labor and material when you work sheet or plate. Eliminates expensive die costs—easy to operate. 7 sizes to choose from.

Write for free catalog on Metalworking Ideas.

. . . or a demonstration right in your plant.

AMERICAN PULLMAX CO., INC.
2485 N. Sheffield Ave., Chicago 14, Ill.

Grinder

STRAIGHT wheel (aerial) grinder can be used with 6 by 1 in. abrasive wheels or with belt grinding attachment. Tool features 2-hp motor with no load spindle speed of 7,000 rpm. Housing castings are all magnesium, entire tool weighs only 13 lb without wheel. Hardened steel helical gears and ball bearings are used. *Nedco Co.*

Circle No. 28

Silicon rectifiers

SERIES of hermetically-sealed, high-current silicon cartridge-type rectifiers are designed for forced-air or liquid cooling. They can be used for damping out oscillation in electric welding circuits. The miniature rectifiers utilize metallized ceramic housing with ferrule-type terminals for insertion into standard 30 amp fuse clips. Available in peak inverse voltage ratings of from 1,500 to 16,000 volts at rectified d-c output currents from 210 to 360 milliamps. *International Rectifier Corp.*

Circle No. 29

NO INJURIOUS FUMES . . .

"ANTI-BORAX"

No. 2 BRAZING FLUX

For Brass, Bronze, Copper, Steel, Malleable Iron, etc. Causes the bronze to penetrate deeper into the joint—making a stronger union than is possible with other fluxes. High efficiency makes it more economical to use. Melting point 300°.

ALSO

1—Cast Iron Welding Flux
3—Brass, Bronze Welding Flux
4—Flux for Bronze Welding Cast Iron
5—Extra Quality Aluminum Flux for Cast Aluminum Welding
7—Steel Flux
8—Aluminum Flux for Sheet Aluminum
9—Stainless Steel Flux
11—Tinning Compound
12—Burnt Cast Iron Welding Flux
13—Brazing Flux for Extruded Bronzes
14—Special Brazing Flux for Aluminum Bronze, Everdur, and all Silicon Bronzes
15—Special Flux for Magnesium Alloys Dow Metal, etc.
16—Silver Solder Paste Flux

FOR THE BEST JOB AT LEAST COST

Weldors can save more money and get a better job on production work, making special tools, and repair work with the right Anti-Borax product—**order by number.** Send for **free sample** and descriptive Circular.

ANTI-BORAX COMPOUND CO., INC.
FORT WAYNE, INDIANA

Matheson

Gas Mixtures

for KAISER ALUMINUM'S NEW QUALIWELD

MIG* Welding Process

Matheson's special Chlorine-Inert gas mixtures eliminate porosity in heavy plate welding of Aluminum or Magnesium Alloys, where more than one pass is needed. Matheson's corrosion-resistant pressure regulators are especially recommended for use with these gases to insure steady, trouble-free operation.

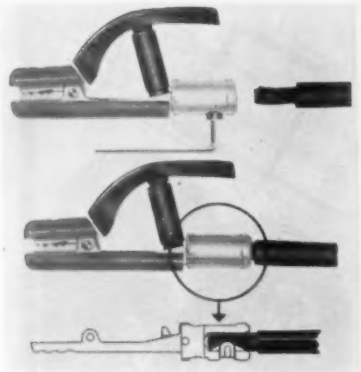
97% Argon, 3% Chlorine—for flat welding
97% Helium, 3% Chlorine—for vertical and overhead welding

* For further information on gas mixtures for Metal Inert Gas welding contact Sales Engineering Dept., The Matheson Co., Inc., P.O. Box 85, East Rutherford, N. J. Matheson offers 76 compressed gases, pressure regulators, valves and accessories. Prompt shipment from 3 plants.

The Matheson Company, Inc.

Compressed Gases and Regulators — *East Rutherford, N. J.; Joliet, Ill.; Newark, Calif.*

See our Exhibit at the Pacific Chemical Exposition.



Electrode holders

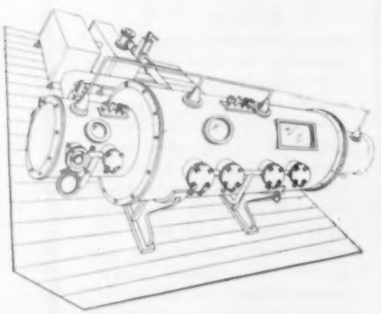
LINE of electrode holders is equipped with "Ball-point type cable connection." Holder can be installed on a welding cable in less than two minutes, firm says. Eliminating the use of shim stock and pressure plate, new connection allows use of larger sizes of cable. Cable socket is drilled in the end of the holder body casting. At right angles to this socket another hole is drilled and tapped. Both holes are drilled $^{9}/_{16}$ in. A cadmium plated ball-point steel screw goes in the tapped hole.

To install holder, simply strip 1 in. of cable jacket, insert cable strands in socket and tighten ball-point screw down directly on cable strands. *Tweco Products Inc.*

Circle No. 30

Weld chamber

FOR welding fuel rod end caps, fuel channels, fuel tanks and other relatively large nuclear and missile components manufactured from materials requiring controlled atmospheres,



welding chamber is 36 in. in diameter, 90 in. long. Ultimate vacuums and pump down time are required, and rotational and longitudinal welding fixtures are featured. Versatility is offered with the ability to attach airlocks, presses and other equipment. *L&B Welding Equipment, Inc.*

Circle No. 31

Look to Cayuga for INGENUITY in AUTOMATION

Tap our warehouse of ideas and experience for both standards and specials.

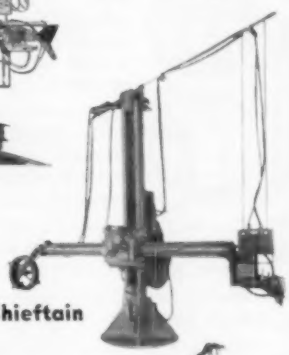
WELDOMATIC MANIPULATORS

The most complete range of sizes and types, truck mounted or stationary. Precision built and designed for automatic longitudinal welding and for use with turn tables, turning rolls and positioners.

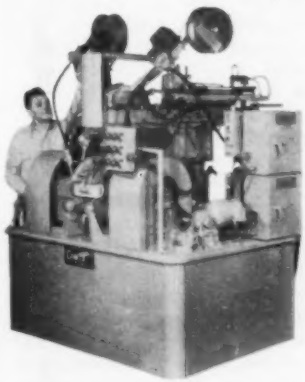
Super Chief

Big Chief

Custom Automatic Equipment to meet your requirements.



Chieftain



Warrior

Write Department WI-3 for complete information—send job specifications for recommendations.

• HORN JIGS • PEDESTALS
• TRAVEL CARRIAGES • POSITIONERS
• TURNING ROLLS • BEAMS
• TURN TABLES
• WIRE REELS

Cayuga

• DESIGNERS
• BUILDERS
• CONSULTANTS

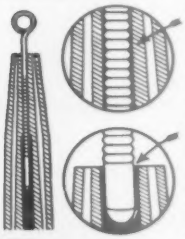
MACHINE & FABRICATING CO., INC.
Depew - Buffalo, New York

World's Finest CUTTING and WELDING TIP CLEANERS

WYPO
WIPES AND POLISHES
Made of STAINLESS STEEL

DOUBLES THE LIFE OF YOUR WELDING AND CUTTING TIPS

The exclusive circle design found only in Wypo Cutting and Welding Tip Cleaners provides as many as 60 more cleaning edges per inch of cleaner.



These rounded outer edges of cleaning ridges clean and polish tip orifice without scratching or cutting.

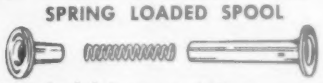
This smooth pilot guides WYPO Tip Cleaner into tip Will not enlarge or damage tip port.

This cross section view of WYPO Cleaning Surfaces shows these exclusive features:

Rounded cleaning surfaces that won't jam or cut.

Straight sided valleys insure thoro cleaning by removing all waste.

SPRING LOADED SPOOL



Spring loaded brass spool. Will not rust. Holds cleaners securely in case.

DOUBLE WOUND EYES

Insures longer life for small sizes of WYPO Tip Cleaners. Will not pull out of case.

NOW AVAILABLE IN 3 CONVENIENT SETS

WYPO TIP CLEANERS
STANDARD SET

CLEANER NO.	FOR DRILL
7	75-74
8	73-72-71
10	70-69-68
12	67-66-65
14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49

MADE IN U.S.A.
PAT. NOS. 2429581, 2473758 IN CANADA 1948

STANDARD SET OF (12) Cleans (27) Drill Sizes Nos. 75 to 49 Incl.

WYPO TIP CLEANERS
JUMBO SET

CLEANER NO.	FOR DRILL
28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
48	30

MADE IN U.S.A.
PAT. NOS. 2429581, 2473758 IN CANADA 1948

JUMBO SET OF (9) Cleans (19) Drill Sizes Nos. 48 to 30 Incl.

MASTER SET

CLEANER NO.	FOR DRILL
7	75-74
8	73-72-71
10	70-69-68
12	67-66-65
14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49
28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
45	30

WYPO TIP CLEANERS
PAT. NOS. 2429581, 2473758 IN CANADA 1948
MADE IN U.S.A.

MASTER SET OF (31) Cleans (66) Drill Sizes Nos. 75 to 30 Incl.

Replacement sets available. Cleaning Range — Cleaner No. & Drill Nos. stamped on back of each case. WYPO GIVES YOU MORE!

SOLD BY LEADING WELDING SUPPLY DEALERS

MAITLEN AND BENSON, INC.
1395 Obispo St., Long Beach 4, Calif.

Radiography unit

LIGHTWEIGHT (45 lb) industrial radiography unit MG 100 is powerful enough for tasks involving steel welds and opaque materials such as aluminum, magnesium, etc. The portable unit is housed in an enameled steel case and connected to tubehead through a flexible multi-conductor cable. Kilovoltage regulation is stepless and continuously variable from 30 to 100 kvp. X-ray generator and tube are enclosed in a shock-proofed and radiation-proofed steel tank weighing 55 lb.

A radiation angle of 42 deg allows wide field coverage, amounting to 76% of the focal-film distance. At full load, 100 kvp at 4 ma, the unit can be operated 50 minutes. *Philips Electronics, Inc.*

Circle No. 32

Temperature crayon

TEMPERATURE indicating crayons for detecting faulty steam traps without disconnecting the trap are available. For example, a 300 F "Tempilstik" will not melt in a properly functioning 100 lb steam system where the steam about the trap is 338 F and below it is 298 F. A chalky mark will remain on the return line about a foot below the trap. If the trap is not working well, live steam will blow through, the temperature below the trap will be 338 F also, and the "Tempilstik" will leave a melted mark. *Tempil Corp.*

Circle No. 33

Dust collector

No moving parts, no nozzles or pumps are found on a new wet dust collector. It delivers discharge air free of entrained water. *Wheelabrator Corp.*

Circle No. 34

Many of these new products can be seen at the American Welding Society's Sixth Annual Welding Show to be held in Kiel Auditorium, St. Louis, April 15 through 17.

Servospeed
HEART OF AUTOMATION
MODERN ELECTRONIC ENGINEERING GIVES PRECISE MOTOR SPEED CONTROL
1/100 — 10 H. P.
Modern industrial electronic engineering has been coordinated with electric motor design to provide a versatile means for obtaining the full possible advantage of speed control in DC motors while operated from the regular alternating current power line. Grid controlled "Thyratron" tubes are utilized for power controlled stepless variation to supply motor armature power. Patented feedback, or "Servo" circuits provide constant torque capability over wide speed ranges of as high as 60 to 1 in some models and a minimum of 20 to 1 in others.
Servospeed
DIV. of ELECTRO DEVICES, Inc.
4 Godwin Ave., Paterson, N. J
ARmory 4-8989

range of temperatures, pressures and vibrations encountered in high altitude flight. Guardite originated the rectangular external strength shell for equipment chambers used to test aircraft and missiles. As early as the first part of World War II, the firm was furnishing altitude cabins for experimental training purposes. Hundreds have been built for the Air Force, Navy, research institutions and industry.

Harris Calorific forms Australian company

Headquartering in Melbourne, Australia, Harris Calorific Ltd. is a new company recently formed by Harris Calorific Co. of Cleveland. The Australian firm will manufacture gas welding and cutting torches, tips and regulators. Distributors include Industrial Oxygen Co., a new subsidiary of Industrial Engineering Co.

A gaseous oxygen plant will be in Melbourne, and a liquid oxygen plant in Sydney, with other oxygen facilities planned for Adelaide, Perth and Brisbane.

Superweld develops descaling process

A new process which removes scale from titanium and stainless steel alloys has been developed by Superweld Corp., North Hollywood, Calif. Invented by Hoyt W. Todd, chief metallurgist at Superweld, the process involves a solution into which the metal components are immersed before the heating cycle. The heat treatment causes an easily-dissolved scale to form on the metal surfaces, the firm says. A standard acid pickling bath then removes the scale.

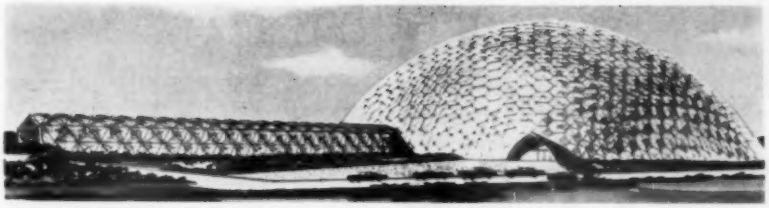
Bay States expands New England plant

At the rate of nearly $2 million a year, Bay State Abrasive Products Co. is expanding its New England plant in Westboro, Mass. The firm has been adding to its facilities at this rate for nearly two years, and has plans for further expansion at home and overseas.

H&H exhibit features high-production brazing

A high-production gas-brazing machine, able to produce a completed impeller every six seconds, will be put through its paces at the ASTE Tool Show in Philadelphia, May 1-8. Built specially for the show by Handy & Harman Co., the machine will demonstrate how low-cost stampings and screw machine parts can be joined into strong, light, economical assemblies, the firm reports. Unusual design feature of the brazing machine will be an automatic feed of the silver alloy into the joint during the brazing cycle.

Included in the exhibit will be aluminum brazing and heat-resistant alloys as well as silver alloys and silver conductive coatings specialized to electronic and electrical applications.



TEN-story high geodesic "Union Dome" will be world's largest circular building without internal supports, Union Tank Car Co. reports. Artist's sketch shows dome and special paint area at left. (See story below.)

Powder metallurgy show schedules talks, exhibits

Speeches to be given at the 1958 Powder Metallurgy show and meeting, Sheraton Hotel in Philadelphia April 21 to 23, include "New powder metallurgy applications in the metal cutting field," by H. Frommelt, Spring Garden Institute, and "Applications and advantages of hardfacing and corrosion resistant surfacing with alloy metal powders," by S. Tour of the Sam Tour Co.

Exhibiting at the show will be General Aniline & Film Corp., Hoeganaes Sponge Iron Corp., Lindberg Engineering Co. and National-U. S. Radiator Corp.

Welded flour bins

"JUST plain arc welded," firm says about these 8-ton, 16-ft diameter flour bins being unloaded after delivery by Baker Perkins Inc. Four bins, each 26 ft high and holding a freight-car load of flour, were built by the Saginaw, Mich., firm in 30 days.

Geodesic dome all-welded

An all-steel, all-welded geodesic dome, reportedly the world's largest circular building without internal supports, is being built in Baton Rouge, La., by Union Tank Car Co., Chicago.

The 10-story high structure is believed to be the first industrial use of a dome structure in this country. The "Union Dome" is 375 ft across at its interior base (longer than a football field.) Total floor area is 110,000 sq ft. The dome and facilities which it will house will cost about $1 million, much less than the conventional car repair plant of this size, according to E. A. Locke, Jr., president of Union Tank Car Co.

The dome will consist of 320 steel panels fabricated in 12 basic sizes and welded together. Panels were specially fabricated from standard ⅛ in. steel sheet and 4 in. tubing. A tunnel-shaped paint building connected to the dome is 200 ft long and 20 ft high. Project is to be finished in mid-1958.

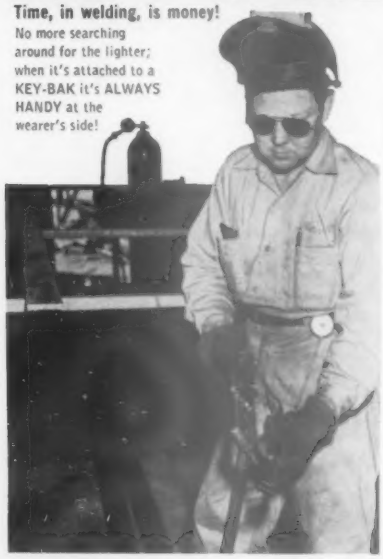
Metal men selected for MEI council

Eleven metallurgists have been chosen to serve on the newly-created National Advisory Council of the Metals Engineering Institute. Sponsor of the recently launched Institute is the American Society for Metals. Board members are: James B. Austin and Edgar C. Bain, U. S. Steel Corp., Pittsburgh; Arthur E. Focke, General Electric Co., Cincinnati; Francis B. Foley, International Nickel Co., Inc., Philadelphia; W. E. Jominy, Chrysler Corp., Detroit; George A. Roberts, Vanadium-Alloys Steel Co., Latrobe, Pa.; Adolph O. Schaefer, Pencoyd Steel & Forge Co., Philadelphia; B. F. Shepherd, Ingersoll-Rand Co., Phillipsburg, N.J.; Kent R. Van Horn, Aluminum Co. of America, Pittsburgh; Ralph L. Wilson, Timken Roller Bearing Co., Canton, Ohio; Harold K. Work, College of Engineering, New York University, New York City.

WELDERS SAVE TIME & MONEY with

KEY-BAK

Time, in welding, is money!
No more searching around for the lighter; when it's attached to a KEY-BAK it's ALWAYS HANDY at the wearer's side!

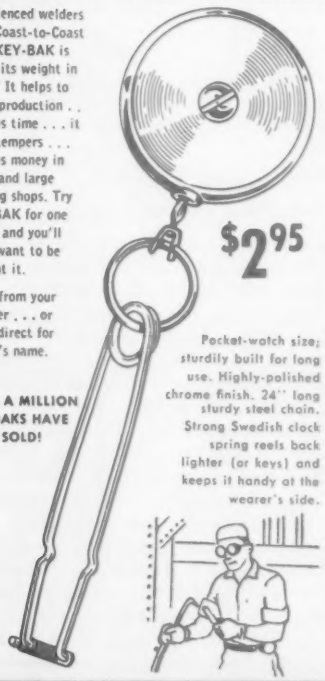


WELDERS SAVE TIME & MONEY with KEY-BAK

Experienced welders from Coast-to-Coast say "KEY-BAK is worth its weight in gold." It helps to speed production . . it saves time . . . it saves tempers . . . it saves money in small and large welding shops. Try KEY-BAK for one month and you'll never want to be without it.

Order from your supplier . . . or write direct for jobber's name.

OVER A MILLION KEY-BAKS HAVE BEEN SOLD!



$2.95

Pocket-watch size; sturdily built for long use. Highly-polished chrome finish. 24" long sturdy steel chain. Strong Swedish clock spring reels back lighter (or keys) and keeps it handy at the wearer's side.

West of Mississippi: LUMMIS MFG. CO. 2242 E. Foothill Blvd. Pasadena, Calif.

East of Mississippi: CTL COMPANY 1710 W. Stewart Ave. Wausau, Wisconsin

Free Europe expands steel industry

Crude steel production of West Germany was increased from 23,180,000 metric tons in 1956 to 24,550,000 metric tons in 1957, according to Phoenix-Rheinrohr A. G. The Duesseldorf, W. Germany firm, one of Europe's largest steel and pipe manufacturers, set sales and earnings records in the past fiscal year.

Stackpole absorbs Pure Carbon

Pure Carbon Co., Inc. will become a subsidiary of Stackpole Carbon Co. Both firms are in St. Marys, Pa.

Norelco holds sales, X-ray meetings

New technical facts and sales ideas were covered at a recent sales session of the Instruments Div., Philips Electronics, Inc. At the home office in Mount Vernon, N. Y., representatives attended discussions on plans for 1958, instrumentation, advertising and promotion and general sales and management policies.

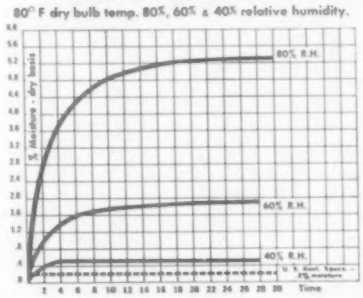
At the firm's X-ray Diffraction School held at Mount Vernon's YMCA, more than 125 chemists, metallurgists, physicists, production supervisors and quality control engineers heard lectures on diffraction and spectroscopy.

Everywhere the weldor went . . .

. . . the portable welder was sure to go. Even in such tight spots as the hammer mill pictured above, the weldor can take Alloy Rods Co.'s portable semiautomatic welder for open arc hardfacing. It weighs only 70 lb, and can be moved easily, the York, Pa. firm says.

HERE MINUTES MEAN DOLLARS TO YOU!

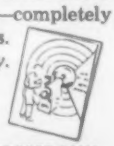
MOISTURE ABSORPTION OF LOW HYDROGEN-TYPE ELECTRODE COATINGS
80° F dry bulb temp. 80%, 60% & 40% relative humidity.



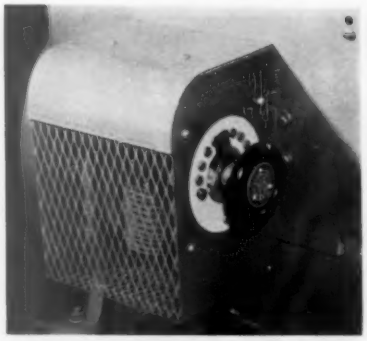
The moment you unpack a mineral-coated electrode, it begins to absorb moisture. As the chart shows, rods can pick up as much as 13 times allowable moisture content within two hours!

DryRod OVEN

DRY-ROD Oven costs only a few cents a day to operate. Storing unpackaged rods in it preserves the original quality of the electrodes . . . protects you against the wastes and dangers of defective welding caused by moisture-absorption. DRY-ROD Ovens are built for heavy duty—completely wired, ready to use. 3 sizes. *New literature now ready. Write*



PHOENIX PRODUCTS COMPANY
4727 N. 27th St. Milwaukee 9, Wis.



Current control does three jobs

Although a Hobart eight-step Thinweld current control is designed for use with an arc welder to provide very low amperage for welding, National Valve Co., Pittsburgh, has found another use for it. One of the firm's jobs uses a spectrograph, an instrument which requires a steady source of d-c power of about 4 amp. To provide steady, low amperage, National Valve is using a standard Hobart 300-amp electric drive arc welder with an eight-step Thinweld. Thus, they can use the portable welder for regular welding, low-amp welding or for energizing the spectrograph.

Survey published on weld strength

"The elevated temperature properties of weld-deposited metal and weldments," is a report covering tensile, rupture and creep properties for carbon, low alloyed and austenitic steel and for complex alloys developed for high strength at high temperatures. The survey, made by the American Society for Testing Materials and the American Society for Mechanical Engineers, will be published as STP 226.

Ajax grants license to Italian firm

Italforni of Milan, Italy, will make electric salt bath furnaces incorporating Ajax Electric Co. designs. The Philadelphia firm recently appointed Italforni as licensee.

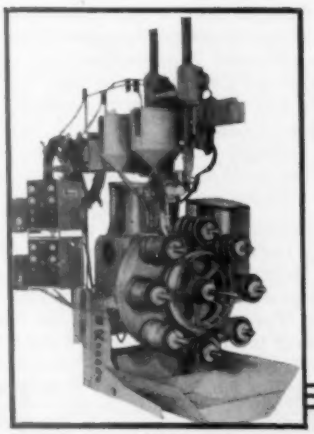
High Voltage expands overseas facilities

Plans to double existing overseas facilities for installing and servicing its Van der Graaff particle accelerators were recently announced by High Voltage Engineering Corp., Burlington, Mass. Acquisition of 51% of the stock in High Voltage Servicing Co., Ltd., of London was the first step in the expansion program, Dr. Denis M. Robinson, company president, disclosed. Eventually the London firm will install and maintain accelerators in Europe, Africa and as far east as Calcutta.

Wasserman commended by Cancer Society

The Queen's Div. of the American Cancer Society recently awarded Rene D. Wasserman *(above left)* its Certificate of Appreciation. President of Eutectic Welding Alloys Corp., Flushing, N.Y., Wasserman accepted co-chairmanship of the Commerce and Industry Div. of the Queens Cancer Crusade for 1958.

SPEED UP CRAWLER PARTS REBUILDING WITH *Rexarc* AUTOMATION



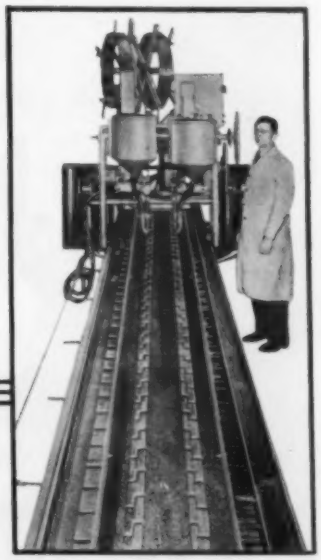
MS-8

Rexarc MS-8 Twin Head Tractor Roller and Idler Rebuilder

- Hard-faces both sides of rollers simultaneously
- Mounts 8 rollers and one idler at a time
- Write for free literature

Rexarc RM-6 Twin Head Tractor Track Rebuilder

- Hard-faces both sides of track simultaneously
- Skips spaces between links
- Ready for rugged service



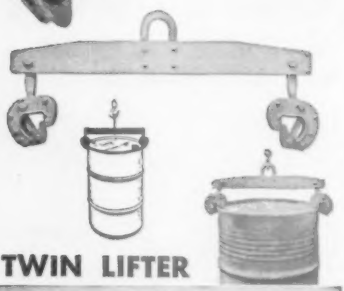
RM-6

See these new machines at our Booth No. 135, AWS Show St. Louis, April 15-17

Manufactured by

THE SIGHT FEED GENERATOR COMPANY
WEST ALEXANDRIA, OHIO

YOUR BEST MOVE . . . MOVE
with MERRILL
MATERIAL HANDLING DEVICES



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COMING EVENTS

APRIL 14-18: Sixth Spring and Thirty-ninth Annual Meeting, American Welding Society with American Society of Mechanical Engineers Conference. Hotel Statler, St. Louis.

APRIL 15-17: Sixth Annual Welding Show, American Welding Society, Kiel Auditorium, St. Louis.

MAY 2: Fifth Annual Conference for Engineers and Architects, Ohio Union, Ohio State University, Columbus.

MAY 5-8: Fourteenth Annual Convention, National Welding Supply Association, Americana Hotel, Miami Beach, Fla.

MAY 12-16: Southwestern Metal Exposition, State Fair Park, Dallas.

MAY 15-16: Third Annual Welding Exposition, Utah State University, Logan, Utah.

JUNE 2-6: National Welding Seminar, Wallberg Memorial Building, University of Toronto, Toronto, Ont.

JUNE 16-18: Compressed Gas Association meeting, Seaview Country Club, Absecon, N. J.

JUNE 30-JULY 1: Independent Oxygen Manufacturer's Association convention, Poland Spring, Maine.

SEPT. 8-10: Canadian Section, Compressed Gas Association meeting, Seigniory Club, Montebello, P.Q., Canada.

Design engineers choose Chicago

The annual Design Engineering show, devoted to materials which go into the making of end products, will be in Chicago's International Amphitheatre April 14 to 17. The three-year-old show has become the third largest annual industrial exposition in the country. Electrical and electronic components, fasteners and adhesives are among the products to be shown.

Ways to achieve a better exchange of information among engineers will be studied at the Design Engineering Conference in Chicago, April 14 through 17, held concurrently with the Design Engineering Show. The design conference, also, will take place in the International Amphitheatre.

Distributor appointments

Glendale Optical Co., Inc., Valley Stream, L. I., N. Y.: Fibre-Metal (Canada) Ltd., Toronto, Ont., Canada; Suppliers Industrial Warehouse, Vancouver, B. C., Canada.

Smith Welding Equipment Co., Minneapolis: H. K. Miller Co., Chicago; Hobart North Welding Supply, Chicago.

NCG Div. of National Cylinder Gas Co., Chicago: Antrim Welding Supply Co., Camden, N.J.

FITE RITE BLANKET

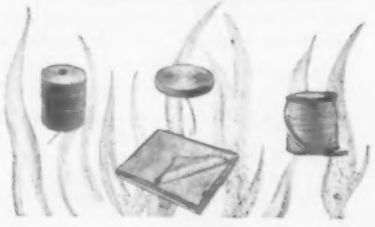
Split-Second fire protection in the Flip-Open Case

...made of J-M Asbestos Cloth by prominent Chicago manufacturer

• Here's an excellent unit for on-the-spot handling of fires—the Fite Rite Blanket in the flip-open case for split-second protection of equipment and personnel. Made of Johns-Manville Asbestos Cloth—in commercial and Underwriters' grades to AAA—the Fite Rite Blanket is produced by Cotton Goods Mfg. Co., 216 N. Clinton St., Chicago, Ill. Standard blankets and curtains made of J-M Asbestos Cloth are also included in the Fite Rite Line.

Fabricators of top-quality clothing, curtains, and other protective materials offer J-M Asbestos Cloth in the forms that are most practical in your operation. For the name of your local distributors and fabricators of products made of J-M Asbestos—or for free booklet TX-2A—write Johns-Manville, Box 14, New York 16. In Canada, Port Credit, Ont.

Johns-Manville Asbestos Textiles



Harold E. Foote has been named vice president and sales manager of Dallas Welding Equipment Co. He formerly owned Foote & Co., Dallas, which was absorbed by Dallas Welding.

Ralph Heindl has been named Chicago branch manager of A. O. Smith Corp.'s Product Service Div.

Poe

Townsend

New officers at Tweco Products, Inc., Wichita, Kan., are: *Roy W. Poe*, vice president and *James L. Townsend*, secretary. Poe will continue as director of sales.

Les A. Thayer has been appointed general sales manager for Belden Mfg. Co., Chicago, and *E. K. Butler* was named manager of marketing services. Both men were former division sales managers. *Hoyne Howe* and *E. V. Blake* were appointed district managers.

K. H. MacWatt has been appointed manager of piping sales at the M. W. Kellogg Co., New York.

Paul J. Foley will fill the newly created position of general manager, resale, for the marketing division of Worthington Corp., Harrison, N. J. He will be in charge of sales of welding positioning equipment, air-cooled compressors, etc. Replacing Foley as manager of sales for the Plainfield, N.J., Div. is *Paul Galton*.

Foley

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WELDER BRUSHES

for all types and makes of welding equipment

Everything you need from *one* source, with *one* responsibility. The fast, economical way to order. Catalog gives complete specifications, factory numbers, scaled drawings, etc. Write for your free copy today.

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WIRE!
1. ANALYSIS GUARANTEED
2. MICROSCOPICALLY CLEAN
3. SAME SIZE END TO END AND PERFECTLY ROUND
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THESE ARE THE FOUR BIG REASONS WHY MORE AND MORE AIRCRAFT AND MISSILE MANUFACTURERS SPECIFY ALUMINUM WELDING WIRE, EXTRUDED AND PRECISION WOUND BY ALL-STATE. FULL STOCK MAINTAINED AT WHITE PLAINS AND AT WEST COAST WAREHOUSE: 4933 FIRESTONE BOULEVARD, SOUTH GATE, CALIFORNIA • ASK FOR ALUMINUM LIST AND DATA SHEET.
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Porto-Screen kits include hinges, tees, treated fabric, hooks . . . everything except ½" pipe or tubing, which you add yourself! Porto-Screen forms a rugged, portable, low-cost, fireproof shield that folds compactly for storage or carrying. Available in 5' or 6' heights, 9', 12' or 15' lengths, with yellow or green UL approved duck, or Weld-Tex neoprene coated glass cloth.

Spa-Fla® LOW COST WELDING SHIELDS

Flexible galvanized wire insert permits forming around the job and rolling up for easy carrying. "D" rings provided for hanging on overhead work. Standard or custom sizes in four UL approved fire, water, mildew-resistant fabrics.

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MILWAUKEE
WELDING ENGINEERS
MACHINERY BUILDERS
ESTABLISHED 1936

Dr. B. D. Thomas will succeed *Dr. Clyde Williams* as president of Battelle Memorial Institute, Columbus, Ohio. Dr. Williams recently retired.

New chief engineer of Tracerlab, Inc., Waltham, Mass., is *Everett Sarratt*. He will be responsible for engineering and development of new products in nuclear laboratory equipment.

Lincoln

Keeney

J. J. Lincoln, Jr. has been advanced to president of Pure Carbonic Co., New York, a division of Air Reduction Co., Inc. He had been vice president of Air Reduction Sales-southern region. Succeeding him in Houston will be *J. H. Keeney*. Lincoln succeeds *E. R. Lawrence* who becomes chairman of the Pure Carbonic division. *L. T. D. Berg* takes the post vacated by Keeney, marketing manager-equipment, Air Reduction Sales Co.

Lowell S. "Lou" Pelfrey has been named director of research and development for International Rectifier Corp., El Segundo, Calif.

C. D. Ramsden has been named president and general manager of the Pacific Coast Engineering Co., Alameda, Calif.

Henry F. Frailey has been named operations manager for power and special purpose tubes at Westinghouse Electric Corp., Elmira, N.Y.

Three executives from Buffalo's Electro Refractories & Abrasives Corp. were named to positions in the Grinding Wheel Institute. *Carl F. Leitten*, firm president, will serve a two-year term as institute director. *George B. Michie* was named to the public relations committee and *Howard D. Leitten*, to the packaging committee.

Admiral Arthur W. Radford, former chairman of the U. S. Joint Chiefs of Staff, was elected a member of the board of directors of Worthington Corp., Harrison, N.J.

District manager in the Philadelphia area for Vickers, Inc., is *Roy Golze*.

Walter F. Munford has been named assistant executive vice president, operations, for U.S. Steel Corp., and *R. Conrad Cooper* is executive vice president, personnel services. New executive vice president, international and raw materials is *M. W. Reed* and *H. B. Jordan* has been named executive vice president, production. *Charles H. Williams* has been appointed administrative vice president, engineering and *James B. Austin* administrative vice president, research and technology.

Oliver E. Shipp, metallurgist, has joined the Sam Tour Co., Inc., New York.

Leon A. Micheline has been chosen distributor sales representative at Tec Torch Co., Inc., Carlstadt, N.J.

C. E. Russell has been appointed steel division plant manager of the Ambridge, Pa., plant of National Electric Products Corp. He is a member of the American Welding Society.

Philips Electronics, Inc. has appointed *Edward J. O'Rourke* sales engineer at its branch office in Mount Vernon, N.Y. Before joining Norelco, O'Rourke was industrial sales engineer for Picker X-Ray Corp., White Plains, N.Y.

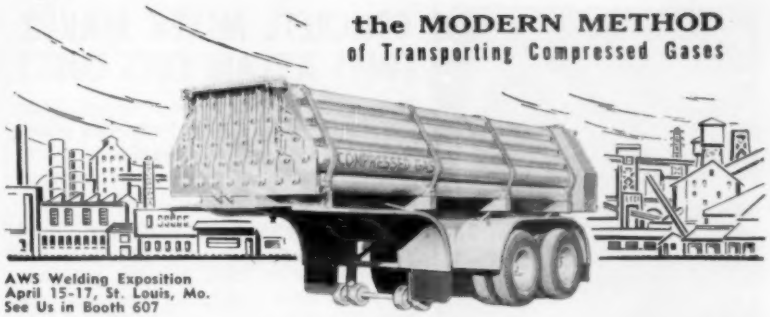
Dr. Alexander Silverman, expert on the chemistry of glass, has been retained as a special consultant to Foote Mineral Co.

Stettner

Coyne

Fred L. Stettner has been elected vice president, engineering-production of Victor Equipment Co. *M. F. Coyne*, former president of California Oxygen Co., is new vice president, gas division, as a result of Victor buying California Oxygen. Both men are directors at Victor.

Eastern representative of Morrison Metalweld Process, a division of Morrison Railway Supply Corp., is *Kenneth E. Templin* of Wyomissing, Pa. He will service railroads, industrial plants and contractors in the mid-Atlantic area for the Buffalo firm.



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Finishing operations on rugged, cast "Ni-Hard" blades for batch concrete mixers was slow and costly for the Besser Co. of Alpena, Michigan—builders of concrete block-making machinery.

But the fast, versatile Arcair process solved the problem of removing riser stubs efficiently. Now in 15-20 minutes per stub, the Arcair torch does a job that once took 2 hours of tedious grinding. Savings in time amount to more than 85%, and consumption of grinding wheels has been cut by 75%.

Arcair can help you too! Basic simplicity—electric arc plus ordinary compressed air — makes the patented Arcair torch, with Arcair Copperclad electrodes, the new, efficient, cost-cutting answer to most metal removing problems.

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THIS IS LOW COST WELDING!

When a touch on a button moves weldments like these into the correct, most convenient position for a downhand pass, you get more arc time, more welding at lower cost. C-F power operated Positioners rotate the work in a full circle at any point in a range of 135° from the horizontal—giving welders a choice of an infinite number of downhand welding positions instantly.

Every requirement for faster, better positioned welding—constant or variable speed table rotation, full 135° tilt, self-locking gearing which holds the table in any position, oversize built-in main tilt, and rotating bearings, choice of two base styles, and many other features—are built into C-F Positioners.

C-F Positioners are available in Hand or Power operated models, and are made in capacities up to 30,000 lbs. and larger.

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CULLEN-FRIESTEDT CO., CHICAGO 23, ILL.

C-F positioned welds mean better, more economical welds

Manager of industrial products sales for Solar Aircraft Co. is *William F. Briney*. He will direct sales from San Diego.

Pike

Chumbley

Thomas H. Pike, Jr. and *John E. Chumbley* have been appointed division vice presidents by Tube Turns, Louisville, Ky., a division of National Cylinder Gas Co. New controller is *F. E. MacDonald*. Pike will be in charge of planning and Chumbley will take over general sales operations for the division.

Charles A. Woodley is a new executive vice president of Caterpillar Tractor Co., Peoria, Ill.

Management changes in four districts of the U. S. Steel Supply Div. include: *William J. Borwick*, promoted to manager of the Chicago district warehouse; *Clyde B. Colwell, Jr.*, manager of the Cleveland district warehouse; *William R. Holmes*, manager of the Newark, N.J. warehouse.

George E. Stalle has been named general manager of the Building Products Div. of American Welding and Mfg. Co., Niles and Warren, Ohio.

T. Pierce Hunter is manager of advertising and public relations for the Budd Co., Philadelphia.

J. Earl Hardesty has been elected vice president-treasurer, and *George W. McCarty* has been named vice president-research and development, of Black & Decker Mfg. Co., Towson, Md.

Dr. Augustus B. Kinzel, vice president of Union Carbide Co., has been named president of the American Institute of Mining, Metallurgical and Petroleum Engineers. Dr. Kinzel received the I.A.A.'s Morehead Medal for 1954.

Goodrich Welding Equipment Corp., Hudsonville, Mich., recently announced the appointments of *J. C. Girod*, chairman of the board; *Arend Bruinsma*, president; *William F. Qualls*, general manager and *Robert C. DeYoung*, secretary-treasurer.

Richard Chase has been appointed purchasing agent of High Voltage Engineering Corp., Burlington, Mass. *Charles Doucette* will head the firm's tube and vacuum department.

New executive assignments at Modern Engineering Co., St. Louis, are: *I. F. Fausek*, chairman of the board; *I. F. Fausek, Jr.*, president; *Willis L. Reedy*, vice president, production; *Al V. Fausek*, vice president, sales; *James F. Fausek*, vice president, industrial sales and *Robert E. Bird*, secretary.

Tom Strouse has been advanced to general sales manager of industrial-medical sales in Liquid Carbonic Div., General Dynamic Corp.'s East Central Region. He will headquarter in Cleveland. *Robert Ellison* replaces Strouse as district sales manager at Cincinnati.

Abraham I. Dranetz has been named vice president of Gulton Industries, Inc., Metuchen, N.J. *Bernard Bernstein* is general manager of the new Advanced Development and Systems Div. at Gulton.

Albert P. Gagnebin and *L. E. Grubb* have been appointed assistant vice presidents of the International Nickel Co., Inc., New York. *Ralph D. Parker*, vice president of Canadian operations, will headquarter in Toronto. *Ralph H. Waddington, James C. Parlee, Richard A. Cabell* and *Paul Queneau* have been elected assistant vice presidents of the Canadian branch of Inco.

Carl Woodrow Hansen has been named chief engineer of Tracerlab's industrial products division, Waltham, Mass. He was with General Electric's X-ray Div. in Milwaukee. *Paul A. McNulty* is new administrative assistant of Tracerlab, Inc.

Robert A. Jewett has been appointed product sales manager of chemicals, phosphors and semiconductors for the Chemical and Metallurgical Div. of Sylvania Electric Products Inc. He will be responsible for developing and administrating sales and merchandising projects for germanium and silicon for semiconductor devices, etc.

Thomas J. Manning has been chosen plant manager of the new Cutler-Hammer, Inc., plant now being built at Lincoln, Ill. He will head manufacturing and administrative operations of the $4 million plant, scheduled for completion in late spring of 1958.

DISTRIBUTORS!

Looking for a Good Line?

Get the money-making facts **now** about ELMET Brand pure and Thoriated Tungsten welding electrodes, the top line in its field.

- **Attractive discount schedule**
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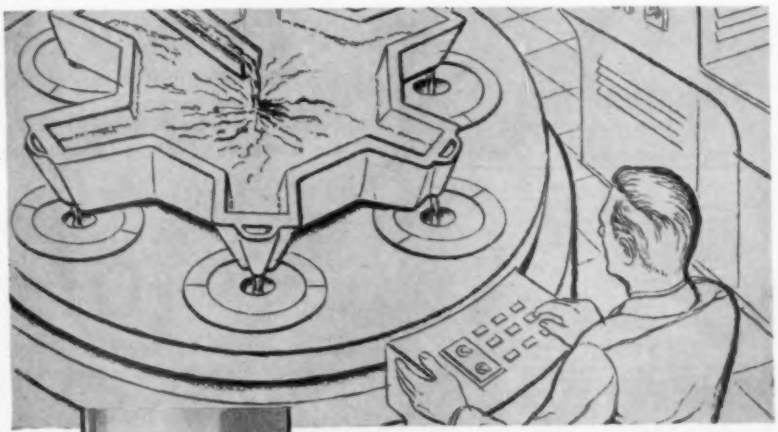

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Complete information, and colorful new 8 page booklet "Low Temperature Brazing Engineering Facts and Data" are yours for the asking.
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FOR HARD FACING OR MILD STEEL WELDING

This high speed semi-automatic welding machine combines the flexibility of the manual electrode with the productivity of automatic welding. Will feed both tubular wires for hard facing, and solid wires for submerged arc, with either AC or DC welders.

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has everything for
Ornamental Iron Shops
The complete one-order supplier for you!
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Ornamental Iron Finish—a plastic-base paint especially developed for painting ornamental metal work. Costs no more than ordinary metal paints. Money-back guarantee. Colors: Gloss Black, Satin Black, White, Primrose Yellow, Natural Gray, Warm Gray, Green.

50-gal. drum ..... $4.26 per gal.
5-gal. can ..... 4.36 per gal.
1-gal. can ..... 4.46 ea.

"CS" Welding Electrodes—Specially designed for welding cast iron to steel or cast iron to cast iron. Clean spatter-free welds! Costs less than other rods for welding cast to steel!

1/8 x 14" (25 lb. box) .... lb. 87¢
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TFC Metal Primer—A superior homogenized primer . . . will not lift or bleed. Excellent coverage. Fully rust-inhibitive. Red or Black.

5-gal. cans ..... $3.15 per gal.
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General manager of Industrial Air Products Co. of the South, New Orleans, is *Ralph Brown*. He was formerly with Delta Oxygen Co., Memphis, and was owner of the Southern Welding Supply Co. for many years.

Leon B. Rosseau was elected president and treasurer of Ajax Electric Co., salt bath furnace manufacturers of Philadelphia.

Otto A. Pfaff, chairman and president of Wheelabrator Corp., Mishawaka, Ind., retired as president but will continue as chairman of the board. *James F. Connaughton*, executive vice president, has been elected president. Pfaff has been with the firm since 1916, serving 22 years as general manager and 17 as president and general manager.

Sales territory of *Frank W. Jenkinson*, district manager for Adamas Carbide Corp., has been expanded to include all of Ohio. He headquarters in Cleveland.

Fred Koukahas has been appointed manager of Chicago Bridge & Iron Co.'s foreign erection division with headquarters in New York. Two sales engineers, *Hugh Minter* and *Robert Hull*, have been given new assignments—Minter to the Tulsa sales offices and Hull to the foreign sales department in New York.

S. R. Zimmerman, Jr. has been appointed general manager of U. S. Asbestos, Grey Rock Div. of Raybestos-Manhattan, Inc. at Manheim, Pa.

Vice president and general manager of Industrial Tubes, Inc., Geneva, Ill., is *Russell K. Soderquist*. He will continue as director of the company.

Clyde E. Arntzen has been appointed manager of the materials engineering department of Westinghouse Electric Corp. *S. A. Rosecrans* will serve as assistant manager of that division.

W. L. Killen is new executive vice president of Downingtown Iron Works, Inc., a division of Pressed Steel Tank Co., Milwaukee.

Died . . .

Mrs. Lydia Wasserman, wife of Rene Wasserman, president of Eutectic Welding Alloys Corp., died March 15 as a result of injuries suffered in an auto accident. Services were held in New York City. Surviving are her husband, infant son, mother and brother.

ANY Pipe Joint or Structural Angle Cut NOW Layed Out in Just MINUTES!

- Marks off easily and accurately any pipe joint.
- Eliminates all figuring of cut backs, and marks all around pipe.
- Saves man-hours, as well as oxygen and acetylene gas.
- Makes it easy to mark off end of lateral pipe.

NO MISTAKES — NO TIME LOSS

—regardless of the type or size of pipe joint to be welded. No more "cut and try" with a **CONTOUR MARKER** — it eliminates the need for calculation, and is available in 2 sizes for marking pipe and structurals of 1½" to 18" in cross section, and from 16" to 48" diameter. Send for complete description.

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1843 E. Compton Bl., Compton, Cal.
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THE CONTOUR MARKER

—and NOW a Battery Operated TORCHIE

for Never Failing INSTANT Torch Lighting ANYWHERE on ANY Welding Job

- **No More Flints**
- **No Loss of Time**
- **Magnetically Held on ANY unpainted Metal Surface**
  - **Steel Girders**
  - **Tanks**
  - **Pipelines**
  - **Boilers, etc., etc.**

Once you try this ALL NEW Battery Operated TORCHIE, you'll wonder how you ever got along without one. Soon saves its costs in flints alone. Only $9.95. Plug in Torchie 110 volts—7 watts, for bench operation—same price. Your Welding Supply Dealer will let you try one on 30 days guarantee. See him TODAY!

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108 S. DeLacey St. Pasadena, Calif.

Arc welding

ARCS IN INERT ATMOSPHERES AND VACUUM. Edited by W. E. Kuhn; published by John Wiley & Sons, Inc., New York, 1957. Cloth, 8½ in. x 11 in., 188 pages. Price, $7.50.

At the 1956 meeting of the Electrochemical Society in San Franciso there was a symposium on "Arcs in inert atmospheres and vacuum" at which 13 papers were presented in 3 different fields: arc welding fundamentals; design and operation of arc welding furnaces and chemical applications of arc.

While none of the papers are devoted exclusively to welding, many of the problems discussed tie in with those encountered in Mig and Tig welding—for example, "Arc properties in the 5 rare gases" and "Characteristics of consumable-electrode d-c arcs in argon, helium and vacuum." Those confronted with theoretical problems in Mig and Tig welding will find theory backed up with practical ideas and applications in this outstanding compilation of papers dealing with the electric arc in inert atmospheres and vacuum.

Data Sheets

FOGLE'S ENGINEER'S HANDBOOK. Edited and published by William Fogle, Los Angeles, 1957. Paper, 8½ in. x 11 in., 100 pages. Price, $15.00.

Fogle's Engineer's Handbook is a compilation of approximately 100 data sheets covering various engineering subjects. Unfortunately, the editor has made it extremely difficult for the reader to determine just what is in the book or where to find it—it has not been indexed.

This volume is in 5 sections, the first of which is devoted to piping, design of pipe hangers and pipe supports. It also includes some information on welding in accordance with the ASA code for pressure piping. Part 2 discusses pressure vessels and again the subject of welding is touched upon. Part 3 runs the gamut of suggested ideas from welding checkered floor plate to how much space is required to park a motor car. Part 4 deals in a theoretical way with pressure vessels, while riveted boiler design takes over in Part 5.

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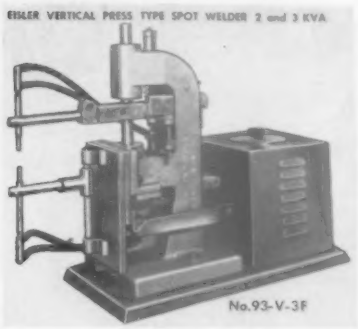

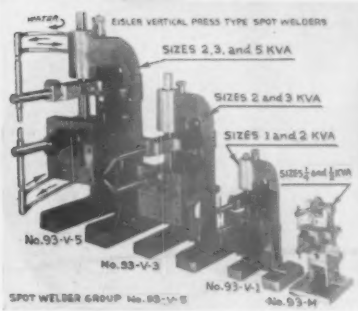

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Arc welding

MANUAL OF INSTRUCTION FOR ARC WELDING. Published by James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, 1957. Paper bound, 8½ by 11 in., 40 pages. Price, $0.50.

This book is an instruction guide to the basic skills of arc welding. It presents arc welding fundamentals with instructions. Written in non-technical language, the book has explanatory diagrams and ideas for useful projects. It can be used for self-instruction or as a text for a basic course in welding.

The manual covers basic welding techniques; effect of heat on metals; preparation of common, high-carbon, alloy and tool steels for welding; brazing; cutting; soldering; hardfacing; pipe welding and sheet metal welding.

Other topics include using the carbon-arc and single carbon torch, welding cast iron, pipe and sheet metal, shop projects and ideas. The book offers an outline for condensed study with an instructor's guide.

Several teacher-trainers in the vocational and industrial field helped prepare the book. The general level of writing and subject matter presentation is aimed at high school teaching.

Fasteners

FASTENERS HANDBOOK. By Julius Soled. Published by Reinhold Publishing Corp., New York, 1957. Cloth, 6 in. x 9 in., 430 pages. Price, $12.50.

Every conceivable fastener type, other than glue or welding, is covered in *Fasteners Handbook*. The volume is encyclopedic in design with an illustration of every fastener under discussion; its description and data covering its features and uses; standard materials and sizes, in which it is available, and sometimes there are editorial comments in addition to names and addresses of manufacturers.

Nuts apparently are highly important fasteners, in the author's estimation; 102 pages are devoted to that subject. Closely following this section are 100 pages devoted to screws, bolts and studs.

In addition to such conventional fastenings as rivets, nails and pins, author Soled also discusses metal stitching, quick-release fasteners, masonry anchoring devices and hose clamps. All in all, the *Fasteners Handbook* seems to be an authoritative reference for current information on many fasteners and fastener resources. But don't look to it for data on glue or welding.

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HELP WANTED—SALESMAN—Welding Supply Distributor in Louisiana needs trained salesman with proven background. Ability to demonstrate electrodes necessary. Write all details, (giving present earnings) to Box No. 418, C/O Welding Engineer, 5826 Dempster St., Morton Grove, Ill.

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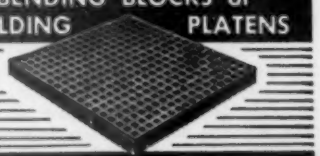

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WELDING TORCHES, New, Rego GV.
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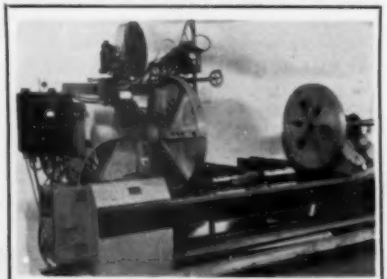

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51. ABRASIVES—Carborundum Co. "Abrasive products for the welding trade," is a 12-page brochure designed as source for abrasive supplies and accessories. Contains specifications, suggested applications.

52. ELECTRODE SELECTION—Lincoln Electric Co. 12-page "weldirectory" tells how to select most efficient electrode for any particular job. Description includes deposition, arc action, amount of slag, bead appearance, etc.

53. WELDER—Graham Mfg. Corp. Page describes "Insul-pin" welder for attaching insulation pins to galvanized duct work. Includes illustrations, specifications.

54. ALUMINUM CHARTS—All-State Welding Alloys Co., Inc. Tables detail old and new type designations for aluminums, gives melt and flow temperatures, plastic ranges and strengths. Similar tables for five solders used to join aluminum to aluminum.

55. HIGH-TENSILE METAL—Harnischfeger Corp. "Evolution of high-tensile weld metal with low-hydrogen electrodes," is reprint of 1957 Adams lecture delivered by D. C. Smith.

56. SPOT WELDER—Vacuum Tube Products Co., Inc. Illustrated page describes 2.5 kva spot welder for light precision spot welding applications. Includes specifications, special features.

57. HANDLE CLAMP—Erico Products, Inc. New "E-Z" change handle clamps are detailed in illustrated page.

58. RESIDUAL STRESSES—LaSalle Steel Co. "Residual stresses in cold finished steel bars and their effect on manufactured parts" is title of 32-page, pocket-size book covering paper given at ASME meeting.

59. EPOXY PREFORM—Technion Design & Mfg. Co., Inc. Bulletin 114 is data sheet on "Epoxweld 100," new single component epoxy preform used in joining.

60. TUBING STEELS—Babcock & Wilcox Co. 4-page folder presents stress rupture data on 14 tubing steels at elevated temperatures and pressures.

61. DOC ALLOYS—All-State Welding Alloys Co., Inc. Folder describes application of 11 alloys and fluxes basic to small plant maintenance where welding torch is used.

62. ADHESIVES—Furane Plastics, Inc. Bulletin describes bonding agents for metals, plastics, rubber, ceramics, etc. Includes information on "Epibond" 126, commercial non-solvent type of adhesive for vinyl plastics.

63. ARC WELDING—Hobart Brothers Co. Volume 14, No. 4 of Hobart Arc Welding News, a 16-page booklet with photos and articles on welding.

64. AXIAL COMPRESSORS—Allis-Chalmers Mfg. Co. Design and construction features of axial compressors (sizes from 8,000 to 1,000,000 cfm) described in bulletin 16B8863.

65. ULTRASONIC TESTING — Sperry Products, Inc. Bulletin 50-107 gives "Inside information on ultrasonic testing services and equipment."

66. ABRASIVE WHEELS — Bay State Abrasive Products Co. Catalog treats abrasive mounted wheels, includes information on grinding action, wheel markings, grade, bond types, abrasive types, structure, grain size, spindles, etc.

67. GM MEN—General Motors Corp. 62-page booklet "Adventures of the inquiring mind," tells of men of science who dared the untried and unknown.

68. ALUMINUM BRONZE ELECTRODES —Ampco Metal, Inc. Fourth quarter 1957 issue of firm's welding news describes application of aluminum bronze electrodes and filler rods.

69. PROTECTIVE COATINGS — Industrial Finishes Co., Inc. 8-page illustrated color brochure on catalytic protective coatings describes its use and adaptability.

70. WELDOR TRAINING—Greer Shop Training Inc. Reprint from WELDING ENGINEER tells of Chicago's Greer Shop Training courses for weldors.

71. TIG WELDING—Air Reduction Sales Co. 24-page catalog 2300 tells of "Heliwelding," firm's Tig welding process for joining of light gage metals and alloys.

72. PROCESS EQUIPMENT — Niagara Welding & Boiler Works, Inc. Bulletin lists facilities, services and qualifications of firm for custom fabrication of process equipment.

73. ULTRASONIC CLEANER—Narda Ultrasonics Corp. Data sheet gives information on ultrasonic cleaner series 600.

74. ARC WELDERS—Reed Welding Equipment Ltd. Volume 11, number 2 of welding news covers national electric arc welders.

75. MOTORS—Lincoln Electric Co. Colorful booklet describes motors with welded steel frame, rotor of welded design and "Multiguard" protection.

76. ALUMINUM IN ADVERTISING—Reynolds Sales Co. Reprint from *Harper's Bazaar* shows effectiveness of aluminum foil in advertising.

77. VALVE—Lunkenheimer Co. Circular 608 details Fig. 405 bronze "N-M-D Globe" valve designed to handle oxygen, nitrous oxide, etc.

78. PHOTODRAWINGS — Eastman Kodak Co. "Photodrawings" is title of publication P-22 telling of technique using photos to convey engineering drawing information in easy-to-visualize form.

79. PUMPS—Kobe, Inc. 12-page bulletin on "Triplex" pumps which operate hydraulic test equipment, mold presses, lubricating systems, oil well pumping, etc.

80. PHOSPHATING COMPOUNDS—Oakite Products, Inc. Folder describes "Cryscoat No. 28" iron phosphate coating material which cleans and conditions metals before painting.

81. ENGINEERING REPORT — Sciaky Brothers, Inc. 50-page engineering report gives "Tentative design standards for resistance-formed welds in mild steel."

82. HYDRAULIC VALVES—Rivett, Inc. Two-color catalog 210 details manually operated, 4-way hydraulic valves. 12-pages cover pipe connected, flange connected and sub-plate mounted valves operated by lever, cam or foot.

83. INDUSTRIAL SAFETY — National Safety Council. "We know better" is pamphlet on industrial safety; another, "Your future . . . keep it clean," concentrates on factory housekeeping.

84. MULTIPRESS—Denison Engineering Div., American Brake Shoe Co. 28-page catalog is designed to show how multipress solves manufacturing problems. Describes operation of press and accessories, gives specifications.

85. DUCTILE IRON—International Nickel Co., Inc. 18-page booklet describes metal with tensile strength up to 200,000 psi, which can be twisted and bent without cracking, as much as 30% elongation.

86. HARDFACING—Wall Colmonoy Corp. Two-color engineering data sheet 32 covers instructions and procedures for hardfacing farm implements. Material recommended and welding procedures indicated.

87. VALVES—Barksdale Valves. 56-page catalog 58-59 gives cross-section illustrations, characteristics and data to aid in selection of valves.

88. TANGENT BENDER — Taylor-Winfield Corp. Struthers Wells machinery for metal forming detailed in 8-page bulletin. Includes tangent benders, roller table, punching and notching machines, etc.

89. AIRLINE WELDING—Airline Welding Sales, Inc. Welding equipment for automatic welding detailed in bulletin 5-12-57. Includes automatic chucking, travel and ejection.

90. INDUCTION HEATING — Induction Heating Corp. No. IHN-15 covers frequency transformers for induction heating.

91. MECHANICAL TUBING—Babcock & Wilcox Co. Technical data card TDC-115D furnishes data from new edition of AISI Steel Products Manual, covers dimensional tolerances of round, seamless carbon and alloy steel mechanical tubing.

92. WATER COOLERS—Baltimore Aircoil Co., Inc. 4-page bulletin describes industrial water coolers for closed system applications.

93. AUTOMATIC WELDING—Century Engineering Co. Information on how your automatic welding problems can be solved by this firm's engineering department.

94. SILVER ALLOY BRAZING—Handy & Harman. Silver alloy brazing of belt buckel detailed in bulletin 78. Gives uses, design, etc.

95. MAGNETIC DRUM—F. W. Shrader Co. Permanent magnet drum type DP is covered in catalog M-14. Describes new design of permanent magnet drums.

96. IMPACT WRENCH—Millers Falls Co. No. 777 impact wrench is covered in form E-21W. Includes specifications, accessories.

97. SEAM WELDING — Taylor - Winfield Corp. Seam welding of low carbon and stainless steels is title of bulletin SP-7A, which explains techniques of making and testing seam welds.

98. TRACING BOARD—Porta Trace, Inc. Folder details fluorescent-illuminated tracing board.

99. WINTER LINERS—Parker Safety Equipment Co. Winter liners for safety hard hats and caps are detailed in catalog page.

100. GAS MASK—Acme Protection Equipment Co. "Pur-A-Weld" special gas mask is described on illustrated page.

101. CLAMPS—Aronson Machine Co. Magnetic clamps can be used to set up on welding table, page says.

102. COPPER—American Brass Co. Publication B-34 is attractive book on copper and copper-alloy. Includes specifications and index.

103. HARDFACING ALLOYS—Coast Metals, Inc. Booklet includes pages on hardfacing tube rods Nos. 80A, 91A, 192T, 92A, 196T, 96A, 98A.

104. CONVERSION FACTORS—Precision Equipment Co. Conversion chart includes inches to centimeters or watts to hp, as well as other conversions.

105. CUTTING—National Cylinder Gas Co. Welding and cutting apparatus is listed in attractive new bulletin NTW-110. Includes cutting torch, cutting tips, regulators, etc.

106. SLING CHAINS—American Chain & Cable Co., Inc. Bulletin DH-54, "Accoloy Kuplex sling chains" describes service program instituted to solve sling chain problems.

107. MICRORADIOGRAPHY — Philips Electronics, Inc. Projection microradiography is detailed in folder. Includes illustrations and applications.

108. DISTRIBUTOR CATALOG—Big 3 Welding Equipment Co. Catalog shows range of products handled, describes services.

109. CARBON TUBING—Babcock & Wilcox. Protective coatings is explained in bulletin ERW-TSL#3. Indicates conditions under which coatings will supply required protection.

110. FANS—Westinghouse Electric Corp. Catalog 1121 entitled "Airfoil centrifugal fans" describes airfoil blading for all-purpose applications in line of centrifugal fans.

ADVERTISERS IN THIS ISSUE

This advertisers' index is included as a convenience and is in no way part of advertising contract. Although every care has been taken to index accurately some errors may have occurred and no allowance will be made for them.

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Literature offered in ads

125. Acro Welder Mfg. Co.—Write for further information on welding machinery, engineered and manufactured to order.

126. Air Reduction Sales Co.—Data available on the ney "Easyarc" stainless steel electrodes.

127. Air Reduction Sales Co.—Write for technical literature on the "Aircomatic MIGet."

128. Alloy Rods Co.—Bulletin AR-8-2 on "Atom-Arc" iron powder low hydrogen electrodes is available.

129. All-State Welding Alloys Co. Inc.—Further information available on aluminum welding wire, also data sheets.

130. Aluminum Co. of America—Further information, books and films available on joining aluminum.

131. American Messer Corp.—Write for full details on the Messer cutting machines.

132. American Pullmax Co. Inc.—Write for catalog on metalworking ideas, also for a demonstration in your plant.

133. Ampco Metal Inc.—Write for the free monthly inventory list of Ampco-Weld rod and bar stock.

134. Ansco X-Ray—Further information available on Ansco's x-ray films.

135. Anti-Borax Compound Co.—Descriptive circular and sample of solder and brazing compounds.

136. Arcair Co.—Brochures available on Arcair's metal removal torches.

137. Aronson Machine Co.—Detailed engineering data available on Aronsons positioners.

138. Aro Spot Welder Div.—Illustrated literature on the new Aro "Model 410" portable spot welder.

139. Atlas Welding Accessories Co.—Further information available on the new wood grip weld cleaning tools.

140. Auto Arc-Weld Mfg. Co.—Write for further information on the "Magna Welder" for hardfacing or mild steel welding.

141. Becker Bros. Carbon Co.—Catalog giving complete specifications and scaled drawings of carbon welder brushes.

142. Bernard Welding Equipment Co.—Further information available on the new "LC" welding system, for high-speed low-cost arc welding.

143. Bridgeport Brass Co.—"Bronze Welding—Modern Tool of Industry," contains data on "No. 192" low-fuming bronze rods and other alloys.

144. Budd Co.—Catalog available on the Nuclear System's radiography machine "Model 52"

145. Cam-Lok Div.—Write for catalog on the neoprene insulated cable connectors.

146. Cayuga Machine & Fabricating Co., Inc.—Write for further information on the Cayuga welding head manipulator; also send job specifications for recommendations.

147. Century Engineering Co.—Tough problems in automatic welding are solved at Century Engineering Company's new facilities in Clifton, N. J. Write for data.

148. Chicago Hardware Foundry Co.—Information on "Fuse-Well" cast-iron welding rods and electrodes is available.

149. Cincinnati Tool Co.—Catalog available on clamps for every purpose and other tools.

150. Columbia Electric Mfg. Co.—Illustrated 8-page catalog on tong-test ac/dc ammeter.

151. Contour Marker Corp.—Information and instruction book on laying out pipe joints.

152. Contour Marker Corp.—Details on establishing and marking a point at any angle.

153. Cullen-Friestedt Co.—"C-F Positioner Catalog" available on low cost welding.

154. Dockson Corp.—New welding catalog No. 58W available on the "Levermatic" welding torch and other welding and cutting equipment.

155. Drawalloy Corp.—Bulletin 355 DC provides complete information on every grade of Drawalloy welding wire.

156. Eastman Kodak Co.—Further information available on Kodak industrial X-ray film type KK.

157. Eisler Engineering Co.—Catalog No. 93-57 shows Eisler's complete line of spot and wire butt welders, and also the vertical type press welder.

158. Erico Products, Inc.—Write for further information on the "Caddy L-163" vulcanizer.

159. Eutectic Welding Alloys Corp.—Write for further information on Eutectic's "Low Temperature Welding Alloys."

160. Federal Machine & Welder Co.—Information on an automated production line ready made to produce a part to specification.

161. Fibre-Metal Products Co.—Write for bulletin 65 on "Supergrip" electrode holders.

162. Frommelt Industries—Write for catalog on Frommelt's welding screens and shields.

163. General Electric Co.—Publication AE-44 available on Xerogadiography explaining the new, high speed method of 100% x-ray inspection.

164. General Electric Co.—Bulletins GEA-6408 (Standardline) and GEA-6593 (Customline) are available on resistance welding controls.

165. H & M Pipe Beveling Machine Co.—Write for complete details on the H & M line of pipe cutting and beveling machines.

166. Handy & Harman—Bulletin No. 20 explains the values, techniques and economics of low-temperature silver brazing.

167. Harnischfeger Corp.—"What You Should Know About Welding Positioners" available.

168. Harnischfeger Corp.—Bulletin R-29, on low-hydrogen electrodes.

169. Harnischfeger Corp.—Further information on AP-100 mild-steel electrodes is available.

170. Harnischfeger Corp.—Bulletin R-48, on heat-treatable electrodes.

171. Hobart Brothers Co.—Write for complete information on the Hobart line and for a sample of the new "Rocket 24" electrodes.

172. Independent Engineering Co.—Further information available on transporting compressed gases by gas supply trailers.

173. International Nickel Co.—"Inco Welding Materials" gives detailed information on welding nickel alloys, cast irons and dissimilar alloy combinations.

174. International Nickel Co.—Illustrated Folder shows where and how you can use "Inco-Weld A" electrodes successfully.

175. Jackson Products—Data on complete line of welding equipment and accessories.

176. Johns-Manville Corp.—Booklet TX-2A available on complete line of asbestos products.

177. K-G Equipment Co.—Complete catalog available on the K-G "Redi-Set," for welding, cutting, brazing, soldering and heating on any job.

178. Krembs & Co.—Samples of "Fluxines" available also charts.

179. Lenco, Inc.—Literature available on the manual arc welding electrode holder.

180. Lewis Welding & Engineering Corp.—Bulletin 7703 describes Lewis' automatic welding head manipulators.

181. Lincoln Electric Co.—Write for the new Weldirctory Bulletin 7000.1.

182. Linde Co.—Write for further information on the new "Heliarc HW-18" hand welding torch, and where you can examine and try it.

183. Liquid Carbonic—Write for details and free literature on oxy-acetylene equipment.

184. Lummis Mfg. Co.—Further information available on "Key-Bak" and name of nearest jobber.

185. Magnaflux Corp.—Write for information on the Magnaflux 4-Point Test Program.

186. Matheson Co.—Further information available on chlorine-inert gas mixtures for metal inert gas welding.

187. Merrill Brothers—Information on lifting clamps, twin and drum lifters, drum tilters and other material-handling devices.

188. Maitlen & Benson Inc.—Further information on "Wypo" cutting and welding tip cleaners.

189. Metal & Thermit Corp.—Folder IP-57 describes the entire "Speedex" iron powder line.

190. Miller Electric Mfg. Co. Inc.—Complete particulars available on the new metallic arc welding machines. "The Roustabout" "The Big Rig" and "The Fireball".

191. National Carbide Co.—Information on calcium carbide available, also name and address of nearest supplier.

WELDING INFO-AIDS

USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

NEW PRODUCTS described on pages 128 to 138

Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

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★ For copies of any manufacturers' bulletins described on these pages, circle the number of the items on card at right. Fill in your name, title, company and address. This has to be done only once on either post card. You need no postage.

★ For additional information on New Products described in this issue, circle the numbers and the items that interest you. The New Products section begins on page 128.

WARNING!

Illegible or incomplete addresses may keep you from receiving the information you desire. And remember, cards postmarked after the deadline date cannot be processed.

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Welding Engineer
P.O. Box 28
Morton Grove, Ill.

Literature offered in ads

(Continued from page 154)

192. National Cylinder Gas Co.—Complete catalog on "Torchweld" regulators and National's welding and cutting equipment.

193. National Welding Equipment Co.—Booklet available "you don't need an egg beater to mix gases".

194. Norton Co.—Write for information on Norton's wheels and how you can benefit from every grinding job you do.

195. North American Philips Co.—Write for distributor territory in your area.

196. Page Steel & Wire Div.—Folder DH-402A, "Submerged Arc and Inert Gas Welding Wire", booklet DH-1277, "Gas Welding Rods," and a welding rod comparison chart are available.

197. Phoenix Products Co.—Literature available on Dry-Rod ovens.

198. Picker X-Ray Corp.—Write for information concerning any phase of radiation-utilization.

199. Picker X-Ray Corp.—Further data available on Picker "Gardray" radiation badges.

200. Pressed Steel Tank Co.—Write for detailed facts and prices on Hackney high pressure gas cylinders.

225. Raco Products Div.—Write for further information on safety garments for welders.

201. J. C. Renfroe & Sons, Inc.—Catalog on complete line of lifting clamps available.

202. Riegel Textile Corp.—Write for further information on Riegel welder's gloves.

203. Robvon Backing Ring Co.—Further information available on Robvon backing rings.

204. Servospeed—Data on feedback circuits for constant torque over wide speed ranges.

205. Shawinigan Products Corp.—Information on calcium carbide available, also name and address of nearest dealer.

206. Sight Feed Generator Co.—Literature available on "Rexarc" RM-6 twin head tractor track rebuilder and MS-8 twin head tractor roller and idler rebuilder.

207. A. O. Smith Corp.—Write for further information on the complete line of A. O. Smith machines.

208. Smith Welding Equipment Corp.—Write for details on the new Smith "Big 98" all purpose combination welding cutting outfit.

209. Stoody Co.—Further information available on Stoody wires for semi-automatic hard-facing.

210. Stulz-Sickles Co.—Write for complete details on "Manganal" wedge bars.

211 Tec Torch Co., Inc.—Further details on the "Tec Visuweld Torch" for faster tungsten inert gas welding.

212. Tempil Corp.—Write for further information on the temperature indicating crayon for welding operations.

213. Tennessee Fabricating Co.—Catalog available on 400 casting designs.

214. Thermacote Co.—Write for further information on the battery operated "Torchie".

215. Tweco Products Co.—Catalog on complete line of Arc Welding Accessories and Tweco-Lite aluminum arc welding cable.

216. Unique Equipment Co.—Details on precision welding head manipulators and welding positioners.

217. United States Steel Corp.—Write for complete information about the application and fabrication of USS "T-1" Steel.

218. United Wire & Supply Corp.—Colorful 8 page booklet "Low Temperature Brazing Engineering Facts and Data" is available.

219. Vickers Inc.—Dealer territories available for qualified welder sales organizations.

220. Victor Equipment Co.—Write for Victor's hardfacing manual showing you the right rod to use and how to apply it.

221. Webb Corp.—Illustrated literature on complete line of tank-production machinery.

222. Westinghouse Electronic Tube Div.—Detailed data available on Thyratron tubes.

223. Westinghouse X-Ray Dept.—Write for information about the full line of portable, stationary and fluoroscopic radiographic equipment.

224. Worthington Corp.—Information on Worthington's line of positioners, automatic welding head manipulators, turning rolls and head and tailstocks.

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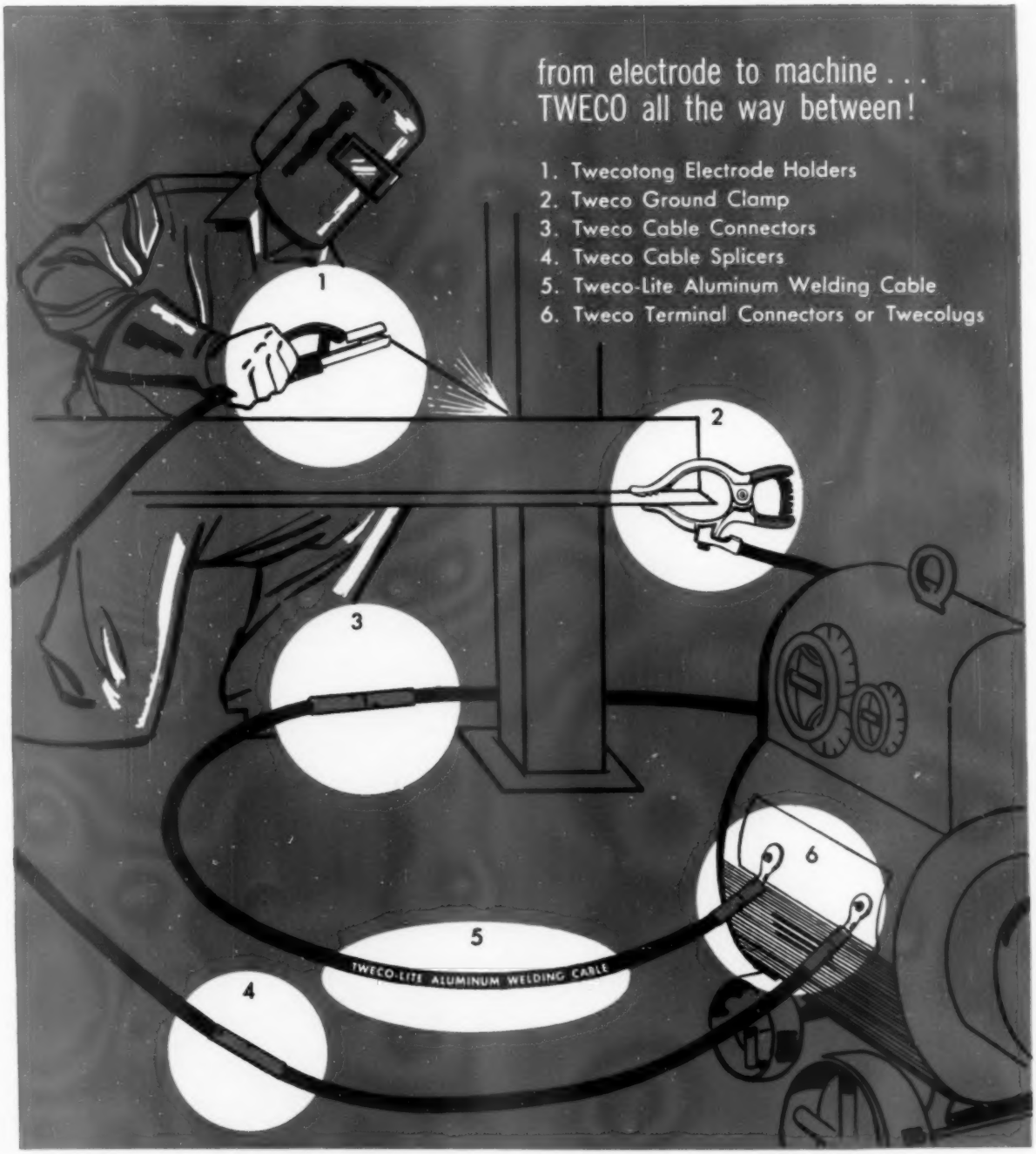

SEE YOUR LOCAL WELDING SUPPLY DISTRIBUTOR

Write for FREE Catalog picturing complete line of Arc Welding Accessories and TWECO-LITE Aluminum Arc Welding Cable

Tweco

MANUFACTURERS: ARC WELDING ELECTRODE HOLDERS, GROUND CLAMPS, CABLE CONNECTORS, TWECO-LITE ALUMINUM WELDING CABLE

PRODUCTS, INC.

BOSTON AT MOSLEY • WICHITA, KANSAS, U.S.A.

Worn high alloy slurry pump parts, once scrapped, now resurfaced with Inco-Weld "A"... last longer than new ones!

Now... one electrode... Inco-Weld "A"* handles most problem welds

...joins most dissimilar alloys, too!

The man in the picture is pointing out the resurfaced section on the cover of a stainless steel slurry pump taken from a Chicago refinery.

A year or so ago, pumps like this would have gone to the scrap heap.

Repair by welding did not seem to be practical. A different electrode would have been needed for virtually every job. And if you picked the wrong electrode and cracking developed, you'd have a bigger loss than if the pump were scrapped in the first place.

Today, with Inco-Weld "A" electrode, repair problems like these are a cinch. Weldors at Cimino Machinery Repair Co. get strong, sound, machinable welds using their regular equipment and procedures. Corrosion resistance of the weld deposit presents no problem. Service records show that the repaired pumps last longer than new ones.

Versatile Inco-Weld "A" electrode also gives X-ray quality welds between many dissimilar alloys . . . ferritic and austenitic stainless steels . . . low alloy and mild steels . . . high nickel and other alloys.

New illustrated folder shows where and how you can use Inco-Weld "A" electrode successfully. Contains case histories, useful tips. For your copy of Inco-Weld "A" bulletin, just write Inco.

Inco Rod "A" is now being called Inco-Weld "A". No change in the product.

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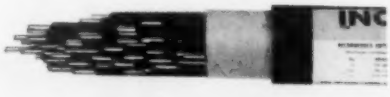
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